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SUPPLEMENTUM NO. 130

# PREVENTION OF CONGENITAL DISLOCATION OF THE HIP JOINT IN SWEDEN

## EFFICIENCY OF EARLY DIAGNOSIS AND TREATMENT

*A symposium held at the annual meeting of the Swedish Orthopaedic Association in Stockholm, on April 5, 1967*

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# Prevention of congenital dislocation of the hip joint in Sweden

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# *Introduction*

BY MAC FELLÄNDER

In 1912 LE DAMANY described a manoeuvre by which unstable hips in the newborn could be revealed (*segno de ressaut*). Many years elapsed before the important discovery led to early treatment of hip dislocation. ORTOLANI, in 1935, was the first to use this abduction manoeuvre (*segno dello scatto*) as a clinical method of early diagnosis and to carry out systematic early treatment. For a long time little attention was paid to Ortolani's works, both in Italy and elsewhere.

In Sweden, PALMÉN introduced Ortolani's method in 1950 and soon succeeded in getting the National Board of Health to recommend, in a circular letter of 1957, this method as a routine procedure for early diagnosis in all the maternity units in Sweden. Since then, virtually all newborn babies are examined for hip dislocation. In a thesis of 1961 Palmén reported data from his own series as well as figures for the incidence in Sweden.

In 1952 VON ROSEN started systematic examination of newborn in the town of Malmö, and he has published several reports of his results (1956, 1959, and later). His papers and his contributions in this field have received great attention in Sweden and in other countries.

Thus, in Sweden we have now experiences from a 10-year period of nationwide early diagnosis and treatment of unstable hips. The Swedish Orthopaedic Association believes that the time has come for discussing this question generally and has therefore asked for reports from some of those who have devoted special interest to these problems.

The symposium comprises submitted papers and contributions to the discussion as well as free discussion.

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# *Preluxation of the hip in the newborn*

**The diagnostic work in Sweden during the years 1953—1966**

BY KURT PALMÉN, FALKÖPING

As I was unable to accept the invitation to the symposium but was later asked to contribute to the discussion, I will first give a short account of the diagnostic work in Sweden. Since the beginning of the 1950's I have emphasized that the examination of the hip must be part of the routine examination of every newborn infant. I have then tried to follow these activities throughout the country and to study what effect the treatment of the newborn has had on the incidence of dislocation later treated in the orthopaedic departments. An account of the series up to and including 1960 will be found in my thesis published in Acta Paediatrica, 1961. Since then, the cases of hip dislocation from the orthopaedic departments, diagnosed after the newborn period, have been compiled for the years up to and including 1966. I will give some data from these series.

## Diagnosis in the maternity departments

In 1953, examination of the hips was started at 26 obstetric departments with paediatric consultants, and in 1956 examinations of the hips were performed at all the 45 departments with paediatric consultants. In 1962 a new drive was started to introduce the examination in all the small maternity units as well. In 1963 it was reported that examination of the hips of every newborn infant was made in 48 departments with paediatric consultants and in 85 smaller maternity units. About 110,000, or 99 %, of the newborn babies in Sweden were delivered in these hospitals. Less than 1 % were born at home.

*Hip examinations and the incidence of preluxation in the newborn in Sweden from 1953 to 1963.*

| | No. of infants born in departments where hips are examined | Percentage of all newborn in Sweden | No. of preluxation cases | Incidence of preluxation ‰ |
|---|---|---|---|---|
| 1953 | 33,000 | 31.0 | 32 | 1.0 |
| 1956 | 47,000 | 44.5 | 76 | 1.6 |
| 1959 | 68,000 | 66.2 | 216 | 3.2 |
| 1960 | 68,000 | 67.4 | 185 | 2.7 |
| 1963 | 110,000 | 99.0 | 615 | 5.6 |

In the first years the incidence of diagnosed preluxation (the term "preluxation" will be used here; the cases of complete luxation in association with malformations are excluded) was about 1 per mill but had increased to 5.6 per mill in 1963. The incidence of "missed" cases was first higher, but the high incidence for 1963 is, in part, very likely due to overdiagnosis. There would seem to be some geographical difference in the incidence for the whole country, but figures of 15 to 20 per mill must be due to overdiagnosis. In the instructions for the technique of examination, which were issued to the maternity departments in 1962, it was stated that only those cases in which the femoral head was clearly felt to be displaceable were to be recorded as "positive", whereas no significance was to be attached to snappings and crepitations. The overdiagnosis suggests that many examiners were too ambitious and perhaps too afraid of missing a case. Some babies, who at the first examination in the maternity department had shown suspected symptoms which were not verified by the orthopaedist at examination a few days later, were included and treated "for safety's sake".

### Cases of dislocation "missed" in the newborn period

A survey of the cases of dislocation which were not diagnosed until *after* the newborn period and treated in all our orthopaedic departments shows a gradual decline of the incidence from about 110—120 cases each year before 1953 (85 % diagnosed after the age of one year) to about 35 each year between 1959 and 1961, with a further decrease to an average of 25 cases in the last four years, from 1963 to 1966. By routine examination of the hips in the newborn and the prophylactic early treatment our cases of later dislocation have been reduced by about 80 % from the time before 1953.

Some cases are still missed at the examination in the maternity departments, and to investigate the causes of this I have looked through the orthopaedic departments' records from 1962—1966 of cases of dislocation detected after the newborn period (here I wish to thank the heads of the departments for their kind permission). I will give some preliminary figures from this material (the survey is not yet completed).

127 cases of subluxation—luxation were not detected in the newborn period. So far, it is known that out of 113 of these babies 56 were born in a department with a paediatric consultant service, 1 was delivered at home, and the rest were born in smaller maternity units with no paediatric consultants.

As more than 80 % of the children in Sweden are born in departments with paediatric consultants, the percentage of missed cases is much higher in the smaller units which lack paediatric consultants.

Out of the 127 cases 5 were cases of malformation: arthrogryposis in 1,

myelomeningocele in 1, myelomeningocele combined with club foot in 1, and club foot in 2.

Out of 97 babies with known birth-weight 14 were prematures, which is about three times the normal proportion of prematurity. In the group of newborn with preluxation, on the other hand, the proportion of prematures was not increased. The probable explanation for the high incidence of prematures may be that many of the premature babies are immediately transferred to a ward for prematures or to a paediatric department and placed in an incubator, and their hips are not examined. The same explanation would be valid for a further two or three babies in the series, who were immediately transferred to an infant ward because of asphyxia and who were in poor condition for a few days.

An interesting observation is that in five infants preluxation was suspected at the examination in the maternity department but X-ray was reported to have been negative; these infants were therefore left untreated. Dislocation was detected later, in two of them not until their second year.

Thus, in most cases it is probably the "human factor" that can be blamed for the failure of detecting dislocation at the examination in the newborn period. If congenital dislocation is not to be missed in the newborn, the following measures would be important:

To make a careful clinical examination of the hips in every newborn infant; not to forget those who immediately after birth are transferred to wards for prematures, infant wards, etc., and those born at home;

to give special attention to the hips in cases of malformation, especially of the bones and joints, such as arthrogryposis, myelomeningocele, dislocation of the knee-joint, and club foot;

not to rely upon a negative X-ray examination.

## X-ray examination of the newborn

Preluxation in the newborn is a condition in which subluxation can be manifest when the leg is held, for instance, flexed—adducted, but reduction occurs when the leg is flexed and abducted to 80—90°. As I pointed out in 1961, the X-ray examination must be made with the baby's leg held in such a position that the examiner can feel that the head of the femur has been displaced (I disregard the cases of malformation with complete luxation) and much depends here upon the assistant who holds the baby during the examination. It is also important to ensure an exactly symmetrical position of the pelvis, since any rotation from one side to the other or different degrees of lordosis will greatly influence the acetabular angle. I am not yet convinced that the X-ray examination provides any information in

addition to the clinical examination and believe that it can be omitted in the practical diagnosis of hip dislocation in the newborn.

It is also obvious that errors can easily be made. Among the infants with dislocation referred to the orthopaedic departments between 1953 and 1966 I have found no less than 35 who showed clear or suspected symptoms in the new-born period but who were left without treatment because of negative X-ray—and without careful checkings.

X-ray examination later on, at the age of 5 or 6 months (earlier if there is a suspicion of subluxation), to check the effects of treatment, and thereafter at, for instance, the ages of 1 and 3 years, may be justifiable in order to follow the growth of the capitular nucleus and the acetabular roof.

## Treatment

Does every newborn infant with signs of preluxation need treatment, and for how long? The displaceability of the femoral head and the "click" disappear within the first week of life in many cases, within one or two days of birth in some cases. This means that the incidence will probably be higher if the examination of the newborn is made on the first day than on the third or fourth day of life. We know that there will be a normal hip development without treatment in many of these cases; various authors estimate these "mild" cases at about 30 %. In some instances in which the baby lay with its legs flexed and abducted to 80—90° I postponed treatment for a few days. If the symptoms had disappeared by then, I left the baby untreated. In other cases, in which the baby tended to lie with its legs more adducted, I applied a bandage, which was removed after one or a few days. If, by then, the hip was stable at an attempt to displace the femoral head, the bandage was not re-applied. The babies who had no or very short treatment were observed particularly carefully for the first few months. In a few cases the treatment had to be re-started, but in the rest of these "mild" cases the hips developed quite normally. In infants with very marked displaceability and hip laxity I extended the treatment to about one month—lately seldom longer.

The short-term treatment was used for the sake of trial and is not, of course, to be recommended as a practice to be followed generally. But I do believe that expectancy is justifiable in the mild cases in which displaceability of the femoral head is noted at examination on the first or second day of life but has disappeared when the baby is examined a few days later. In some clinics abroad they do not treat infants in whom the clinical symptoms disappear within the first week of life and consider that this policy works satisfactorily.

## Secondary bone changes

As regards the *secondary bone changes* discussed at the symposium, much is still unclear. In some respects, such changes probably depend upon the treatment and the time at which it is started. If treatment is started within the first week of life, secondary bone changes develop very seldom. In the earlier part of my own series, which now comprises about 130 infants, there were two cases of necrosis of the head and a few of slight dysplasia. Among about 50 cases from 1961—1967 there were two of dysplasia which persisted at the age of two or three years.

The short-term treatment that I have tried for the last eight years was designed partly to study potential bone changes. The results are not yet ready for publication, but I hope to be able to present them shortly.

## *Summary*

In Sweden, since 1953 hip examination is a routine at the obstetric departments. In the last years almost every newborn is examined (more than 99 % are born in hospitals). The incidence of diagnosed preluxation is about 5 per mill (there are still some overdiagnosis).

Thanks to this diagnostic work and the immediate treatment of the newborn the cases of later dislocation have been reduced from 110—120 cases yearly before 1953 to 25 in the last years. Still some cases are "missed" in the newborn, most of them owing to the "human factor".

# *Instability of the hip in the newborn*

**Fifteen years experiences in Malmö**

BY SOPHUS VON ROSEN, MALMÖ

I presume that you are all more or less acquainted with the principles of diagnosis and treatment that have for many years been used at the department of orthopaedic surgery, Malmö General Hospital, and will therefore confine my paper to a few remarks and mainly on the results of treatment.

The long term results are largely what I reported at the meeting of SICOT in Paris in September 1966. The material consists of all cases treated at Malmö in the years 1952—1960 and after-examined in 1965—1966. Of the some 24,000 infants born at the department of obstetrics in Malmö, instability of the hip was diagnosed in 38 new-borns with all together 68 unstable hips. The duration of follow-up is given in Table 1.

At the after-examination the following clinical and roentgenological observations were made.

*Clinically* all the children except two were symptom-free. One of these was a girl who from 12 months of age had developed spastic paraplegia with consequent defective abduction and reduced range of motion of both hips. The other was a 12 year old girl who complained of weakness of one of the hips. (Fig. 1 b).

*Roentgenologically* the children were examined for

a) poor development of the acetabulum with subluxation and/or
b) Perthes-like changes of the femoral head.

a) *Poor development of the acetabulum with subluxation*

Apart from the above case with paraplegia two hips showed subluxation of the femoral head. The subluxation of one of these was only slight (Fig. 1 a). The other hip was the one which felt weak on exertion. Here roentgen exam-

*Table I. Ages of Thirty-six Children Re-examined*

| Age in years | Number |
|---|---|
| 6—9 | 25 |
| 9—13 | 11 |

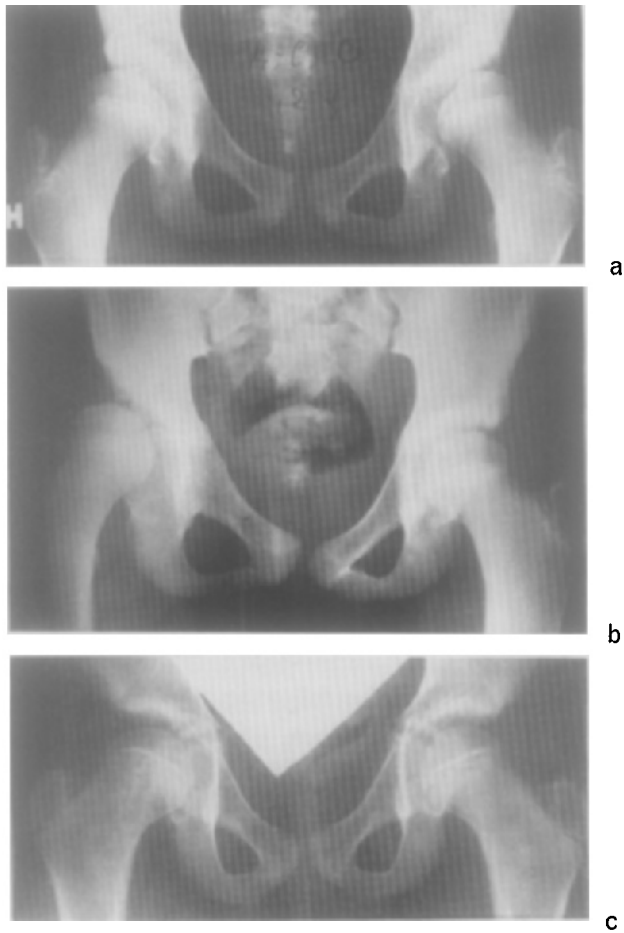



Fig. 1. The three girls in the long-term follow-up, who did not show quite normal X-rays, all of them treated before we developed our present routine treatment. a. Slight subluxation left side. b. Marked subluxation right side. c. Slight shortening and thickening of the right femoral neck.

ination showed a wide acetabulum with a sloping roof and marked subluxation of the femoral head (Fig. 1 b). Both cases belonged to the first eight we had treated, *i.e.*, before we had obtained sufficient experiences and, above all, before we had realised that the femoral head must be held in reduced position *continuously* from the very beginning of treatment if the desired result is to be achieved. In both cases the mothers found the treatment troublesome and occasionally removed the abduction bandage then used. The result was that these hips did not become stable until the children were about 1 year old. It should be mentioned that in both cases both hips

were unstable immediately after birth and that in each child one hip soon became stable despite the inadequate treatment.

b) *Perthes-like changes of the femoral head*

In none of the children were any Perthes-like changes of the femoral head observed. Only in one case did one side show a slight shortening and thickening of the femoral neck (Fig. 1 c). Also that case belonged to the first eight. Treatment was started when the child was three weeks old and the hip in question remained unstable for eight months. The development of the other hip, which was also originally unstable, was normal.

## Comments on diagnosis

The following questions deserve special attention:

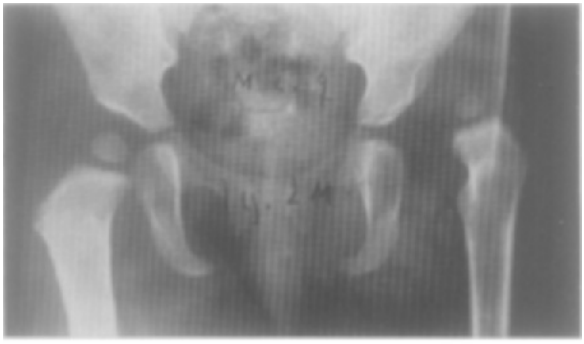
a) Table II shows the *frequency of diagnosed cases* during a 10 year period (1956—1965). The frequency varied considerably from year to year. I cannot offer any satisfactory explanation for this variation. During the entire period the children were examined by the same team of paediatricians at the department of obstetrics and by the same roentgenologists and by the same orthopaedists.

A certain increase may be partly explained by the fact that during this period it was gradually realised how important it is to diagnose the condition early if satisfactory results are to be obtained, with the consequence that all newborns were examined still more carefully. Another possible contributory reason is the increasing number of immigrants to Malmö from Jugoslavia, Italy and other Mediterranean countries.

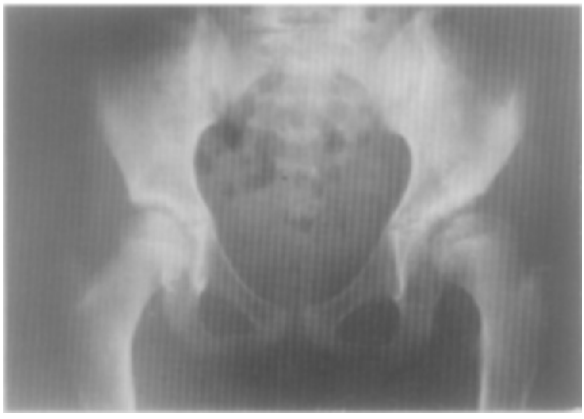
b) *How many cases of instability of the hip have remained concealed at the*

*Table II. The Incidence of Congenital Instability of the Hip in Live Births in Malmö 1956—65*

| Year | Number of cases | Per cent |
|---|---|---|
| 1956 | 4 | 0.13 |
| 1957 | 5 | 0.16 |
| 1958 | 12 | 0.37 |
| 1959 | 7 | 0.21 |
| 1960 | 9 | 0.28 |
| 1961 | 18 | 0.53 |
| 1962 | 9 | 0.27 |
| 1963 | 29 | 0.77 |
| 1964 | 26 | 0.65 |
| 1965 | 52 | 1.29 |



a



b

Fig. 2. The first case missed at the routine examination at the maternity dept. A left-sided dislocation, indicated by the fact that the child limped when starting to walk, was diagnosed at the age of 14 months. Closed reduction was performed resulting in a persistent subluxation at the age of 11 years.

*department of obstetrics?* Four, all in girls, in 1956, 1960, 1963 and 1966, respectively. The first case was discovered by the fact that the child limped when she began to learn how to walk (Fig. 2 a). The parents were living elsewhere and the child was treated there with closed reduction and a plaster cast. Treatment appeared to offer no difficulties, but the result was subluxation (Fig. 2 b). The reason why this case was missed at the department of obstetrics might be that the child had asphyctic convulsions the day after birth and was therefore transferred to another department.

The second and third cases were also betrayed by a limp when the children began to walk in the beginning of the second year of life (Figs. 3a and 4a). Both were treated at the department of orthopaedics in Malmö with closed reduction and Lorenz cast (plaster), in one case combined with adductotenotomy. The results obtained were satisfactory in both cases (Figs. 3b and 4b).

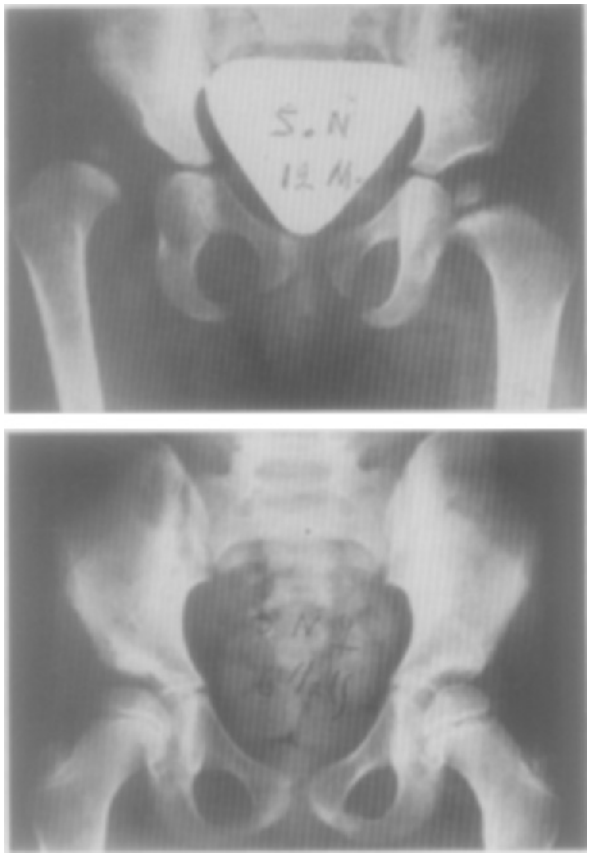
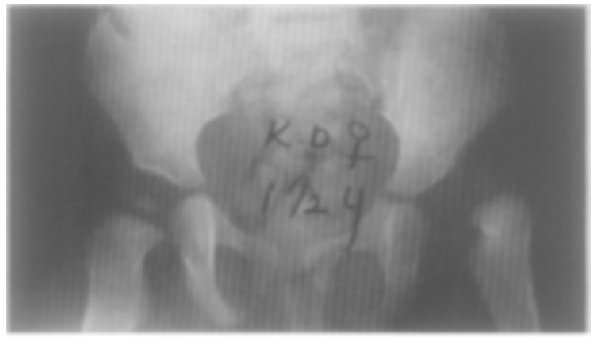



Fig. 3. The second case missed at the routine examination at the maternity dept. X-ray at the age of 12 months showed a dislocation, clinically indicated by a limp on the left side. After closed reduction and adductortenotomy the joint has developed satisfactorily.

It is not known why these cases were missed at the department of obstetrics; it must presumably be ascribed to the so-called human factor.

The fourth case was manifested by impaired abduction of both hips. The child was then one month old. Roentgen examination showed bilateral dislocation of the hip (Fig. 5). Treatment has proved difficult and is not yet concluded. The reason why this case was missed may have been that the femoral head might have been so highly dislocated already at birth that on manipulation it did not reach the same level as the lip (edge) of the posterior part of the acetabulum with the result that it was not possible to produce the reduction click. This assumption is strengthened by observations in another one of our cases. At examination at the department of obstetrics some slight atypical clicks of one of the hips were perceived in this case. To make



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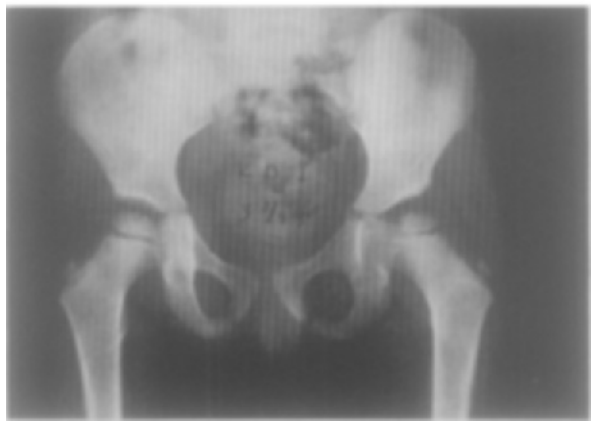

b

Fig. 4. The third case missed at the routine examination at the maternity dept. When the girl started to walk at the age of 17 months there was a limp on the left side. Closed reduction was easily performed and the hip has developed satisfactorily.

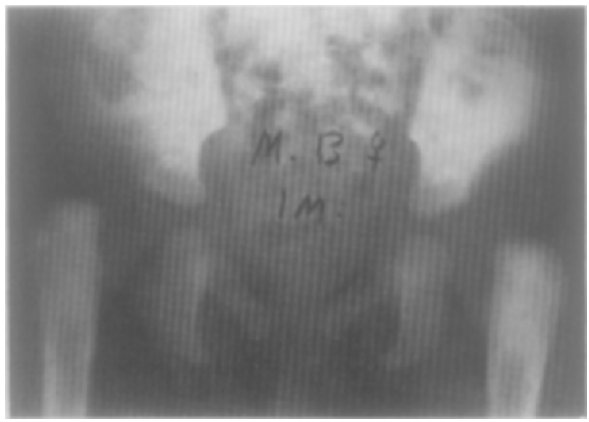

Fig. 5. The fourth case missed at the routine examination at the maternity dept., at the age of one month. A high dislocation on both sides, manifested by limitation of abduction, was discovered at a routine examination in the postnatal clinic.

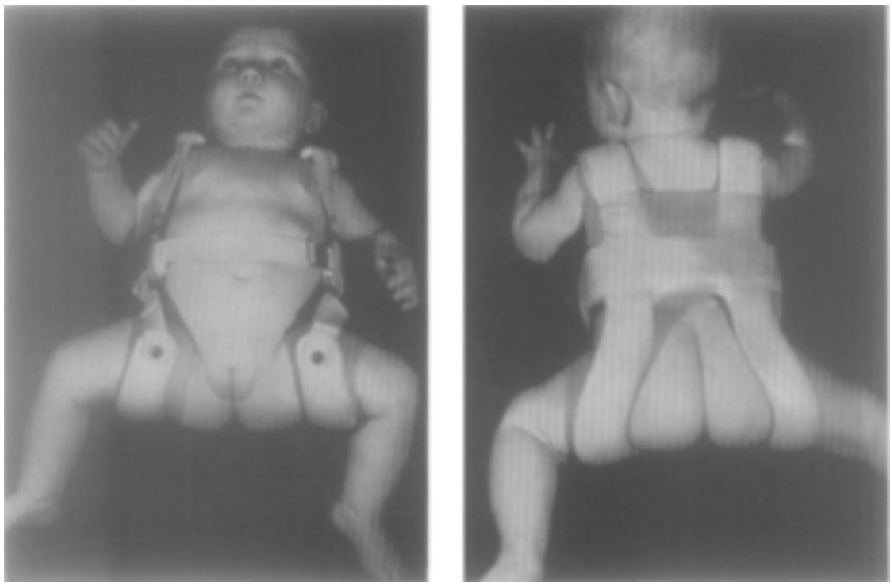

Fig. 6. A larger model of our frame, strengthened by straps, is recommended for strong and lively babies in order to prevent them for wriggling the legs out of the frame.

sure, the child was referred to the roentgen department. Examination there revealed bilateral high luxation dislocation. Both hips could be reduced without difficulty and routine treatment resulted in a normal development of the hips.

**Comments on treatment**

Since 1956 all diagnosed unstable hips have been treated with the abduction frame constructed at the department of orthopaedics in Malmö. In my opinion the advantages of this frame are that when properly applied it holds the hips in reduced position and, secondly, it can be worn when the child is being washed and, thirdly, treatment of the child can without any difficulty be managed by the mother. The child is re-examined every 2—3 weeks at the outpatient department of orthopaedics, where the frame is removed and the child is given a bath. Originally the appliance was made in only one size but now somewhat larger and smaller models are also available. One should take care that strong and lively children do not wriggle one or both legs out of the frame. In such cases, which are uncommon, the legs can be held more firmly in the frame by application of a few straps on the frame (Fig. 6).

*The children's age at beginning of treatment* during the 10-year period (1956 - 1965) are given in Table III.

*The duration of treatment* during the same period is given in Table IV.

Fig. 7. The last X-rays of a girl at the age of 6 years, which revealed an unusual degree of instability of the hips and of the pelvic junctions at birth. In spite of routine treatment in our frame followed by plaster for 6 months the left hip remained unstable up to the age of 10 months. The girl is clumsy with gynecomastia and an endocrine disorder is suspected.

Of the eight cases treated for more than 3 months, four were treated for up to 4 months, during the last month mainly only during the night. Two of the remaining four were the first to be treated with our newly constructed frame. At that time we were not sure how long the frame should be worn.

The case treated with plaster is of particular interest.

The patient was a girl with highly marked instability of the hips as well as of the pelvic joints. We had begun to wonder whether it was really necessary to keep the child in the frame for such a long period as three months, and since both hips felt stable after 3 weeks the frame was removed. At follow-up three weeks later the right hip was still stable, but the other one was very

*Table III. Ages at the Beginning of Treatment (1956–62)*

| *Age in days* | *Number of cases* |
|---|---|
| 1–2 | 45 |
| 3–4 | 10 |
| 5–6 | 6 |
| Total | 61 |

*Table IV. Duration of Treatment (1956–62)*

| Months | Number of cases |
|---|---|
| Up to 1 | 1 |
| Up to 2 | 4 |
| Up to 3 | 48 |
| More than 3 | 8* |
| Total | 61 |

* Up to 4 months 4
With splint, larger model 3
Partly plaster-of-Paris 1
} 8 cases

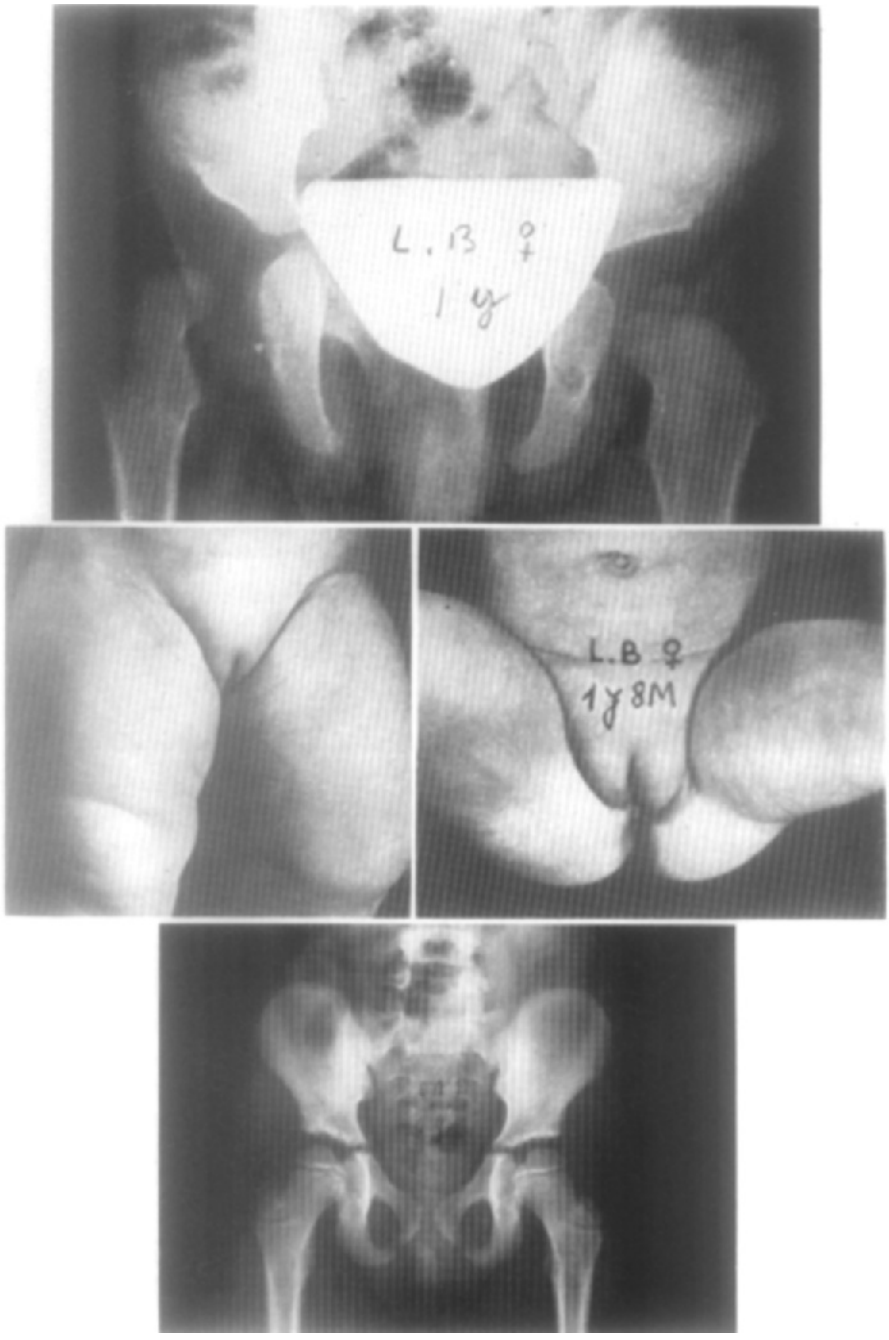


Fig. 8. A clumsy baby-girl with bilateral instability in the hips at birth, treated in our routine way. Both hips became stable within three months. At a follow-up at the age of 10 months the right hip was unstable again with incipient dysplasia of the acetabular roof. After 8 months treatment in a larger model of our frame the hip became stable and has developed normaly. The general configuraton of the girl became more normal.

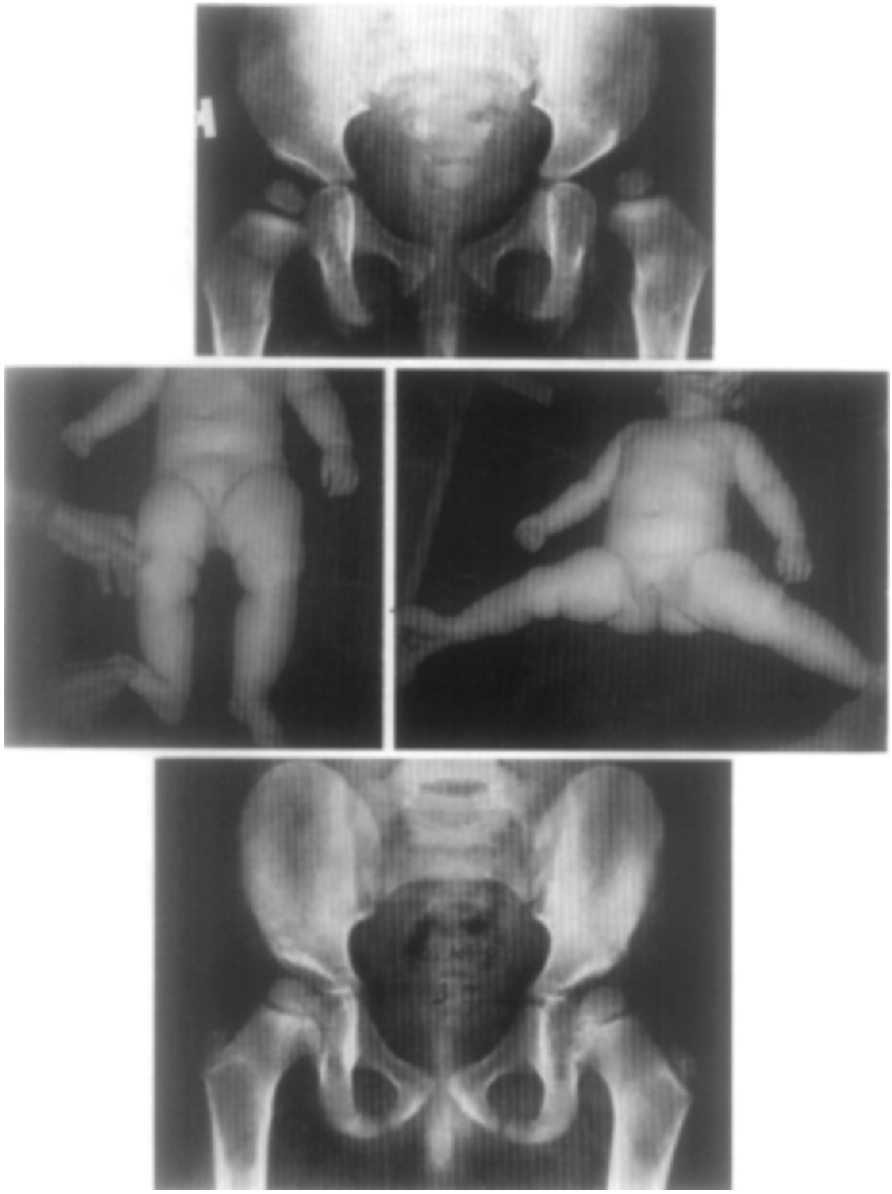

Fig. 9. Another clumsy baby-girl with hypermobile joints and bilateral instability in the hips at birth. With our routine treatment both joints became stable in the reduced position within three months. At a routine follow-up at the age of 12 months the left hip was unstable again and X-rays revealed dysplasia of the acetabular roof. After 4 months of renewed treatment in our frame the hip became stable and the acetabular roof developed satisfactorily. The general configuration of the girl is now quite normal.

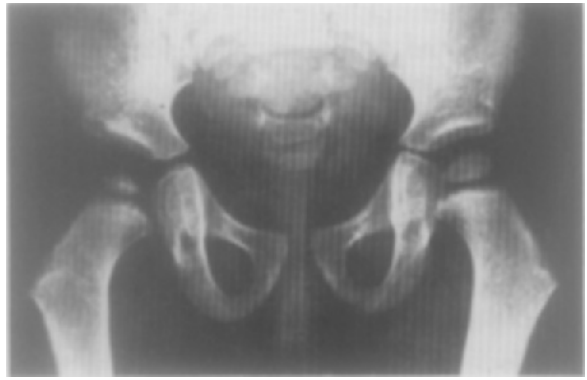

Fig. 10. X-ray of a recently treated girl with marked heredity for C.D.H., a cousine of the girl shown in fig. 8. Both hip joints were highly unstable at birth. In spite of routine treatment for three months the right hip remained unstable. A plaster of Paris was applied for one month followed by a larger model of our frame up to the age of 9 months. The joint became stable and now seems to develop normaly. There is a general hypermobility in all joints, but otherwise the body build is quite normal.

unstable and remained so for 10 months despite immobilisation in plaster from 4 to 10 months of age. Both hips afterwards developed in a normal way (Fig. 7). This girl has always been and still is rather clumsy and her joints are hypermobile. Some sort of endocrine disorder is suspected because of inter alia gynecomastia.

An unusually crude body build and general hypermobility of the joints was also noted in the only two cases with recurrent instability of the hips, both after primarily successful routine treatment. At the routine follow-up of these girls, at the age of 10 and 12 months, respectively, instability of one of the hips was noted with dysplastic acetabulum on the same side. Both girls were placed in a larger model of the frame, one for 8 months and the other for 4 months. When last examined roentgenologically the hips appeared practically normal. The outer shape had also become normal (Figs. 8, 9).

The last case in which the course of treatment deviated from that in the others was, strangely enough, one of my grand nephews, who was born in December 1966 with high severe instability of both hips, preponderantly on the right side. There is a strong hereditary on the maternal side. The maternal grandmother and maternal aunt have dislocation of the hip and the child's cousin is one of the above-mentioned cases with recurrent instability. Treatment was started in the usual way and the left hip became stable after 6 weeks' treatment. But the right hip was still unstable after 3 months, and roentgen examination showed signs of acetabular dysplasia. The hip

was recently placed in Lorenz plaster and I hope, and believe, that also this hip will become stable and develop normally. The child has hypermobile joints, but is of otherwise normal body build.[1]

Summing up, I believe that this method of treatment devised by us is adequate, but one should be on the watch for children with crude body build and hypermobile joints and also for children with hereditary predisposition. It is possible that our treatment was somewhat too rigorous and that some of the children might not have required any treatment at all. On the other hand, treatment does not entail any real inconvenience and has never had any undesirable effect.

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## *Radiography of the hip joint in the neo-natal period*

**Demonstration of X-ray pictures**

BY LARS ANDRÉN, MALMÖ.

### *Reference*

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[1] Two years have elapsed since then. After 1 month in plaster the right hip was stable and reduced and the plaster was replaced by a larger model of our frame. This was removed when the child was 9 months old. The child began to walk at 14 months and has since run about in a normal way. Roentgenologically the left hip is normal and the right hip has gradually developed in a satisfactory way. On both sides development of the bone nucleus in the femoral epiphysis is retarded (Fig. 10).

# *Result of treatment from birth of unstable hips*

**A 5-year follow-up**

BY CARL HIRSCH & SVEN SCHELLER, GÖTEBORG

## Introduction

In the early fifties Palmén and Selander, pediatricians at different children's hospitals in Sweden, started to examine all newborn for dislocation of the hips. Since practically all children in Sweden, in 1958 98.9 per cent, are delivered in maternity wards a great number of new-born were referred to orthopaedic departments the first days of life when Ortolani's phenomenon or only unstable hips explained as slack joint capsules had been noticed. Many previous reports had convincingly illustrated that early abduction treatment of congenital hips led to anatomical normalization (Putti 1929, 1933, Froelich 1932, Hilgenreiner 1935, Frejka 1941, Hart 1950). The interest for immediate care grew rapidly throughout this country, encouraged by von Rosen (1956), Palmén (1961), Andrén (1962). Long term follow-ups of closed reduction by the method of Lorenz (1920) have been presented by Wiberg (1939) and Severin (1941) illustrating the inefficiency of this treatment and the number of problems at later age. It is therefore imperative to investigate the development of early treated hips in which at the time of management very few really had a dislocated joint but rather something that was felt indicative of CDH. The purpose of this presentation is to report the present results of the children born in Göteborg in 1961 and 1962.

## Material

In Göteborg all children are delivered in two maternity clinics. Each child is examined during the first day of life with regard to hip-joint stability. The frequency of unstable hips in Göteborg was in 1961 for boys 6: 3077 (0.2 per cent) and for girls 32: 3062 (1.1 per cent). In 1962 the rate was in boys 6: 3210 (0.2 per cent) and in girls 49: 2971 (1.7 per cent). Arthrogrypotic infants were not included.

In these 93 infants 123 hips were unstable, 30 were bilateral and 63 unilateral; 31 on the left and 32 on the right side.

Roentgenograms were taken in all these children. Radiographic indications of congenital hip dysplasia and dislocation were defined with regard to mean and pathologic values at time of birth. 25 hips were considered

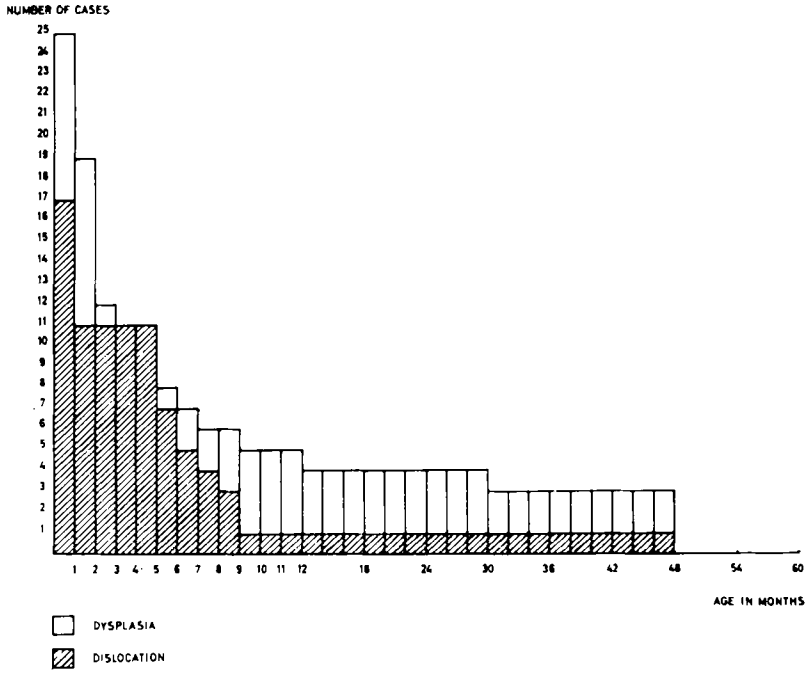
dysplastic or luxated, e.g. 20 per cent of the total number of unstable joints. The incidence of radiographically visible changes were in 1961 amongst boys 0.03 per cent and girls 0.4 per cent. In 1962 the figures were 0.06 and 0.3 respectively.

It is hard to tell if those hips which already at birth show evidence of CDH are the only ones to develop a real dislocation if not treated immediately and how many of the radiographically normal hips with clinical signs of instability with or without Ortolani clicks will cause acetabular disturbances and different degrees of joint malformations. It is quite obvious that at least some unstable hips will be normal very soon even if no treatment is given. The degree of instability varies. It is most pronounced the first day of life. Some will be stable if reexamined a few days or a week later. In this study only those were treated where the orthopaedist was able to confirm the findings of the pediatrician both seeing the patient within a day or two.

In order to have some idea of the difference in frequency of dislocations a comparison was made between children born in 1954—55 when early treatment was not completely organized and in 1961—62 when all new-born were compulsorily checked. Since the orthopaedic department is the only hospital in Göteborg where the citizens can bring their children if hip involvement is recognized they will turn up sooner or later. Everyone born in 1954—55 regardless of when he or she was admitted for hip disorder, was checked. Those with a diagnosis of CDH were recorded. Naturally in this way children with asymptomatic dysplasia or subluxation escaped our efforts. The frequency of congenital dislocations of hips based on radiographic evidence in 1954—55 and in 1961—62 were compared. The incidence was somewhat higher when control at the time of birth was effective.

Even if such a comparison may speak in favour of early roentgenograms in order to find the really severe hips, it is obvious that many of the unstable hips will during the radiographic examination lie in a normal position. Attempts have been made to take X-rays while the femoral head is forced out of its position. In this way some more may be regarded as positive findings but there will still be the majority showing normal roentgenograms. Many of these may nevertheless be potential dislocations. A slack capsule allowing the femoral head abnormal motion in the acetabulum may affect the anatomical shape of the joint (Langenskiöld & Sarpio 1957, Wilkinson 1963, Stanisavljevic & Mitchell 1963). We therefore decided to treat all children with unstable hips in abduction. In doing so, however, we did take into consideration the question whether such a joint position might effect the development of the joints, whether or not it could harm the epiphysis. Radiograms have been taken at 3 months, one year, two years and at four-five years of age.

Radiographic normalization of hip dislocation and dysplasia following early abduction treatment




## Treatment

Most of the children were splinted in a Frejka type of pillow, a few received the aluminium frame of von Rosen or Palmén. The time in abduction varied. In general they were kept 2—4 months. During this period they were checked several times in the out-patient department. If the radiograms did indicate dysplasia or luxation they remained in abduction longer. Eventually a plaster of Paris (double hip spica) was made.

## Results

At one year of age 89 of the 93 children showed radiographically normal hip-joints. One year later one more child had a normal joint. At age four, two children showed very mild dysplasia and in one joint there was only a small difference in the levels of the epiphyseal bone centres in the diagram indicated as dislocation (Fig.). At age five all these children had normal hip-joints.

No radiographic changes have remained in the femoral epiphysis indicating that early abduction is harmful. Delayed development of the epiphyseal bone centre is quite common on the affected side but becomes normal some months later and remains normal.

**Summary**

The frequency of unstable hips in new-born in Göteborg was in 1961 0.2 per cent for boys and 1.1 per cent for girls, in 1962 0.2 and 1.7 per cent respectively. One third was bilateral, one third affected the right and the same proportion the left hip-joint. 20 per cent showed radiographic indications of dysplasia or luxation.

All infants were treated in abduction immediately. With few exceptions a Frejka type of dressing was used, in general during two-four months. The children were all checked at intervals radiographically. Within one year 96 per cent (89/93) had completely normal hip-joints. A year later one more child had developed a normal hip. At age four, two children still showed evidence of mild dysplasia and one hip was slightly subluxated. At age five these three hips were normal.

As a rule the femoral epiphyseal bone centre developed later on the affected side. No signs of disturbances occurred. After the epiphyseal bone centre had become equal-sized, it remained normal.

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# *Analysis of a material of congenital dislocation of the hip*[1]

BY U. JAMES AND J. A. SEVASTIKOGLOU, UMEÅ

The present paper concerns an analysis of a series of congenital dislocations of the hip (CDH), observed in the Department of Orthopaedic Surgery, University Hospital, Uppsala, in children born during the years 1962 to 1965.

Besides typical cases of congenital dislocation of the hip—preluxation (Palmén, 1961)—the series includes some atypical cases, such as dislocation combined with other congenital malformations (e.g. arthrogryphosis and myelomeningocele).

## Material

*The patients:* As demonstrated in table I, altogether 373 children born between 1962 and 1965 were referred to the Department because of diagnosed or suspected CDH.

The material is divided into two groups: "newborn", 255 cases, referred before 2 weeks of age, and "infants", 118 cases, referred after 2 weeks of age. Of the total number, 90 were boys and 283 girls, the ratio for both groups being approximately 1: 4.

*Table I. The material.*

| | No. of "newborn" referred before 2 weeks of age | No. of "infants" referred after 2 weeks of age | Total | Total load |
|---|---|---|---|---|
| Girls | 194 | 89 | 283 | |
| Boys | 61 | 29 | 90 | 373 |
| Delivery in the University Hospital | 242 | 53 | 295 | |
| Delivery in other hospitals | 13 | 65 | 78 | 373 |

[1] Part of the present material has been published by T. Hiertonn and U. James, Uppsala (J. Bone Joint Surg., 50-B: 542-545, 1968).

From the Department of Orthopaedic Surgery, University Hospital, Uppsala, Sweden. Head: Prof. T. Hiertonn, M.D.

The distribution of the patients by the age at which they were referred and first examined in the Orthopaedic Department is shown in table II. More than 88 per cent, or 214 of the newborn, were examined during the first week of life; 87 per cent, or 103 infants were admitted to and examined in the Orthopaedic Department during their first year. 242 newborn and 53 infants were born in the maternity ward of the University Hospital and 13 and 65, respectively, in maternity wards of other hospitals in the Uppsala region.

*Diagnosis:* The hips of all the children born in the University Hospital were examined in the maternity ward by a consultant paediatrician. Children born at other hospitals were examined in the maternity ward, either by the surgeon in charge or by a consultant paediatrician. All the children were later examined on several occasions at the children's welfare centres by paediatricians or general practitioners. Every child, in whom abnormality of the hips was diagnosed or suspected, was immediately transferred to the Department of Orthopaedic Surgery at the University Hospital, where a second examination was performed by one of the senior members of the staff.

The diagnosis in the newborn was always based on clinical findings, such as Ortolani's click, positive provocation test by Palmén's technique, decreased abduction of the hip, apparent shortening of the leg, and suspected crepitations. X-ray examination was performed in the newborn in exceptional cases only.

*Treatment and results:* Among the total number of children admitted to the Department, 13 newborn and 69 infants were assessed as completely normal and not in need of treatment. The remaining 291 received one of three different types of treatment, as shown in table III.

*Newborn:* The standard treatment was by abduction in a splint, almost exclusively of the Frejka pillow type, usually for three months. No complications were observed in any of the cases thus treated. A small number of newborn, altogether 10 babies, received special treatment, either with plaster in abduction position or by closed reduction because of persistent dislocation.

*Table II. Age and number of children at first examination in the Department of Orthopaedic Surgery, Uppsala*

| Age in days..... | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10—14 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| No. of newborn . | 6 | 30 | 32 | 53 | 30 | 38 | 25 | 10 | 10 | 8 | 242[1] |
| Age in months.. | ½ – 1 | 1 – 3 | | 3 – 6 | | 6 – 12 | | 12 – 14 | | 24 | |
| No. of infants... | 7 | 27 | | 40 | | 29 | | 10 | | 5 | 118 |

[1] Only children born in the maternity department of the University Hospital are included.

Among the newborn who received special treatment, 7 were born at the University Hospital. Five of them had typical CDH and two atypical CDH (myelomeningocele and arthrogryphosis).

In 4 of these latter cases the reason for special treatment was a slight acetabular dysplasia diagnosed at the regular three-month checkings. After a period of prolonged abduction treatment in plaster the hips of these babies developed satisfactorily.

*In the other 3 cases (2 typical and 1 atypical) the dislocation persisted in spite of primary treatment by means of a Frejka pillow:*

In the first case dislocation of one hip and subluxation of the other were diagnosed on the third day after birth. The baby was treated with a Frejka pillow for 8 weeks but dislocation persisted. Closed reduction was therefore performed and a plaster cast was applied for a further 8 months. The development was then very satisfactory. In the second case laxity of one hip with Ortolani's click was diagnosed on the fifth day after birth. The baby was placed in a Frejka pillow for 2 months. The X-ray examination 5 months later showed, however, dysplasia of the acetabulum with subluxation of the femoral head. Closed reduction was therefore performed, and a plaster cast was applied for 7 months. The development of the hip was then very satisfactory. The third case (the atypical one) occurred in a baby with arthrogryphosis in whom dislocation of both hips was diagnosed the fifth day after birth. Traction of the hips was applied for some days and closed reduction was then attempted, but the result was not satisfactory. After open reduction of both hips and prolonged immobilization in plaster a very satisfactory result was obtained.

*Infants:* Out of the 118 infants between 2 weeks and 2 years old referred to the Department of Orthopaedic Surgery because of diagnosed or suspected hip abnormalities, only 49 received any form of treatment. 23 of these children were born in the University Hospital and had therefore been examined immediately after birth in the maternity department. In 18 out of these 23 cases treatment was considered indicated because of slight ace-

*Table III. Distribution of the children by applied treatment.*

| | Non-treated cases | Treated cases | | | |
|---|---|---|---|---|---|
| | | Standard treatment | Special treatment | | Total treated |
| | | | Simple | complicated | |
| "Newborn" | 13 | 232 (222) | 6 (4) | 4 (3) | 249 (229) |
| "Infants" | 69 | | 32 (18) | 17 (5) | 49 |

Figures in parentheses denote the number of babies delivered at the University Hospital.

tabular dysplasia, small capital epiphyses, or limitation of abduction but no established dislocation. As far as we know, the hips later developed normally in all these 18 children.

*The remaining 5 cases (4 typical and 1 atypical) occurred in children with established dislocation who received special treatment:*

In three of them dislocation of one hip was diagnosed between 3½ and 4 months after birth. Closed reduction and immobilization in plaster gave very satisfactory results in all 3 cases. In another child dislocation of one hip was diagnosed at the age of 1 year. The child had been treated earlier for congenital megacolon but no other congenital abnormalities had been found. The dislocated hip was treated by closed reduction and immobilization in plaster, also with a satisfactory result.

The fifth case (the atypical one) was that of the child with multiple congenital anomalies, such as anal atresia, urinary-tract malformations and deformity of the sacrum. Dislocation of one hip was diagnosed soon after birth, in about the 4th week of life, and was treated first by immobilization in plaster and later, because of a pronounced dysplasia of the acetabulum and valgus deformity of the hip, by open reduction combined with a varisation osteotomy.

## *Discussion*

The present material is composed of a) children born in the maternity department of the University Hospital, 295 cases, and b) children born in maternity departments of other hospitals in the Uppsala region, 78 cases. All the children belonging to the first group were examined for abnormalities of the hip joints by a consultant pediatrician, as a rule on the first and seldom later than the third day after birth. The material of group *a* is therefore considered to be more homogeneous and reliable than that of group *b* and will be analyzed separately below.

Altogether 11,868 children were delivered in the University Hospital during the four-year period 1962–1965. In 242 newborn the consultant pediatrician found positive or suspected signs of CDH by the primary examination. These babies were referred to the Orthopaedic Department. The incidence of referred cases thus amounted to as much as approximately 2 % of all the births (table IV). Earlier analyses of similar Swedish materials have provided data suggesting a lower incidence of these abnormalities. Thus, among 12,391 examined newborn a total incidence of positive Ortolani's click or subluxation provocation of 2.7 ‰ has been reported (Palmén 1961) while among 11,375 examined newborn genuine dislocation was diagnosed in 2.4 ‰ and doubtful dislocation in another 1.2 ‰, making a total of 3.6 ‰ (Emnéus, 1966).

The strikingly higher incidence observed in the present material is undoubtedly attributable to overdiagnosis of these abnormalities in the Uppsala series. The primarily suspected or established diagnosis was verified at the second examination in the Orthopaedic Department in only about 57 % of the admitted, but the incidence is still almost 2 to 3 times as high as that reported earlier. The newborn babies who did not get any form of treatment comprised 5 %, although the primary diagnosis could be verified in only 57 % of the total number of newborn. This means that about 40 % of the newborn underwent the standard treatment, in spite of the fact that no signs of hip abnormality could be verified at the orthopaedic examination. The reason for this overtreatment was usually that one or more days elapsed between the two examinations, and that the indication for treatment was based on the findings of the primary rather than on those of the second examination.

*In 5 cases (including 1 atypical case), or 0.42 ‰ of all the births, an established dislocation, diagnosed later, was not detected in the maternity department at the primary examination, which thus failed.*

The dislocation was detected in all cases but one, however, before 4½ months of age. The primary examiner in the maternity department has a "key role", and he is responsible if laxity is overdiagnosed or missed. Repeated examinations in the newborn period seem to be important.

*The fact that 3 cases (including 1 atypical), or 0.25% of the total number of births, showed persistent dislocation in spite of early treatment with a Frejka pillow, indicates that this treatment is not always sufficient.* Much better results with the use of the other types of splints have been reported (von

*Table IV. Frequency data relating to 11,868 children born between 1962 and 1965 in the maternity Department, University Hospital, Uppsala.*

| | Number | Percentage of referrals | Percentage of total number of births |
|---|---|---|---|
| "Newborn" referred with suspected CDH | 242 | | 2.0 |
| Standard treatment | 232 | 95.8 | |
| Other simple treatment | 22 | 9.1 | |
| Other complicated treatment | 8 | 3.3 | |
| Unsuccessful standard treatment in typical CDH | 3 | 1.3 | |
| "Infants" referred with established CDH | 5 | | 0.042 |

Rosen 1956, Palmén 1961, Emnéus 1966). The absence of femoral-head necrosis or other complications in the children treated with a Frejka pillow, however, contrasts with the high frequency of complications in children treated with other types of splints, as reported at this meeting (Felländer et al. 1970).

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# *Instability of the hip in the newborn*

**Classification for selective treatment; pathogenesis of the dislocation and complications**

BY M. FELLÄNDER, H. GLADNIKOFF & E. JACOBSSON

Since 1958 examination of the hips in newborn infants by Ortolani's method has been a routine procedure in the maternity units in the Stockholm area. Ortolani's "segno dello scatto" ("signe de ressaut") signifies *essentially that there is a ridge over which the femoral head is felt to glide.* A "click" is an unfortunate error in translation of segno dello scatto. Clicks of unknown nature can often be felt on palpation at Ortolani's manoeuvre but, unlike gliding, they are harmless phenomena which have no relation to Ortolani's sign. We prefer the term "ridge phenomenon".

## Own material

In the Stockholm area virtually all the infants with suspected hip dislocation have been transferred to the Children's Hospital Samariten for further investigation and treatment. Over the period 1958 – 1960 we found 114 hips with gliding over a ridge in 81 newborn examined clinically and radiographically at 1 to 4 days of age. The distribution by sex and involved side will be seen in Fig. 1. They were followed clinically and radiographically up to the age of 5 to 7 years, with the exception of 11 children, who were observed only up to the age of 2 to 4 years and could not be traced for follow-up examination.

## Clinical examination

Clinical examination is, in the main, carried out in the same way as that originally described by Le Damany and commendably revived by Ortolani (and by Palmén in Sweden). In its classical simplicity, Le Damany's description of this "ressaut" deserves to be quoted here.

'L'enfant est couché sur le dos sur une table. L'opérateur se place en face de lui. Avec douceur, sans aucune force, il saisit chacune des jambes du nouveau-né avec la main de nom opposé, de telle sorte que la commissure de son pouce embrasse le genou de l'enfant.

From the Children's Hospital Samariten and the Orthopaedic Department, St. Göran Hospital, Stockholm

## Instability of the hip in new-born infants
## 1958 - 1960
81 children 114 hips

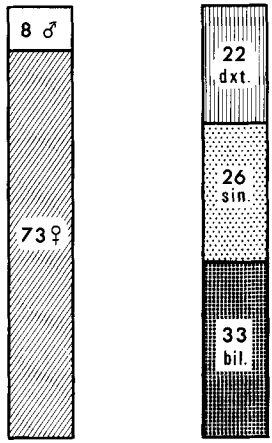



Fig. 1. Distribution by age, sex, and site

La pulpe du pouce est appliquée sur la face interne de la cuisse, l'index sur la face antérieure, le médius est étendu le long de sa face externe et sa pulpe appuie sur la région trochantérienne. L'annulaire et le petit doigt repliés entourent le mollet. La cuisse est maintenue fléchie à l'angle droit sur le bassin, la jambe est également fléchie à l'angle droit sur la cuisse. L'opérateur utilise volontiers l'un de membres inférieurs pour immobiliser le bassin pendant qu'il examine l'autre. Dans un premier temps, la cuisse fixée, comme il est dit, est portée en adduction pendant que la pulpe du pouce propulse légèrement de dedans en dehors l'extrémité de cette cuisse et pendant que la commissure du pouce appuie sur le genou. Si la hanche est subluxable, on sent parfois une secousse due à la subluxation de la tête fémorale. Dans un deuxième temps, l'opérateur imprime à la cuisse un déplacement inverse. La pulpe du médius pousse le trochanter d'arrière en avant et de dehors en dedans pendant que la cuisse est portée en abduction. Par cette manœuvre, si elle est subluxée, la tête rentre dans la cavité cotyloïde par dessus le bord postérieur, et cette rentrée s'accompagne toujours d'un ressaut. Parfois léger, souvent forte net, il arrive que ce ressaut soit assez bruyant pour qu'on l'entende.'

The *clinical examination* in our cases was made

*partly* as simple abduction or adduction without exerting any pressure at all on the thigh in any direction,

*partly* by using the technique described by Le Damany for provocation of this ressaut.

We observed three degrees of instability which were not sharply defined and the following clinical grouping was obtained:

1. *Instability without dislocation*—the joint head is in normal and constant position in the acetabulum but can be dislocated dorsally ("subluxation provocation");
2. *Instability with inconstant dislocation;*
3. *Constant dislocation.*

We based the indications for treatment on these degrees of instability.

*Instability without dislocation* disappears within 1 to 7 days (occasionally longer time); treatment is not necessary.

*Instability with inconstant dislocation* implies that a ridge or gliding phenomenon (signe de ressaut) is felt once or several times at repeated examinations. Spontaneous correction and stabilisation can also occur within 1 or 2 weeks in these cases. All cases will not heal spontaneously, however. It takes an experienced examiner to decide whether to treat such a hip promptly or to await possible spontaneous regression. We have sometimes used expectant treatment for up to 2 weeks, before making the final decision. In each case this decision was then based on the X-ray examination together with the tendency to spontaneous healing.

*Constant dislocation* is treated promptly by immobilisation in an abduction splint.

The group that was thus left untreated but was under careful observation comprised 39 children with 45 affected hips (Table I). The remaining 42 children with 69 affected hips were treated in a von Rosen splint for 2 to 4 months. Most of them were kept in the hospital for a short time, so that the mothers could learn to nurse them in their splints. The splints were removed at bathing or changing of nappies, care being taken to assure that the child's legs remained in the abducted position.

## X-ray examination

The initial X-ray examination of the newborn requires only one straight anteroposterior view of the pelvis, in which the cranial borders of the pubis

*Table I. Instability of the hip in newborn 1958—1960*

| Examination technique | Treatment | No. of children | No. of hips |
|---|---|---|---|
| Ortolani's abduction manoeuvre | Abduction splint 2—4 months | 42 | 69 |
| Subluxation provocation | None | 39 | 45 |
| Total | | 81 | 114 |

and ischium are projected in the same transversal plane. The thighs should be extended in the hip joints and rotated inwards so that the lesser trochanters are barely visible (Fig. 2). The ossification zones of the acetabular roofs will be clearly visible and on subsequent films in the same view even small deviations from the rapid neonatal ossification process will be seen.

*Anatomy of the hip in the newborn.* Two-thirds of the acetabular roof are chondral (Fig. 3). The osseous surface of the roof appears plane and steeply sloping and is very short (Fig. 2). The bone usually ends laterally in a margin at the transition into cartilage. This margin is very small or absent at late ossification. This is not dysplasia but an *ossification anomaly.*

A periacetabular recess on the outer side of the edge of the labrum is visible in anatomic specimens (Fig. 3). At *arthography* the contrast in this recess (Fig. 4 b) indicates the position of the edge. The adjoining half of the acetabular roof is still chondral. The *articular surface* of the roof consists of a single caudally directed concavity. Consequently, the plane, steeply sloping, short osseous surface of the roof *is unusable in the assessment of the articular surface.* The pressure from the femoral head is distributed over the entire acetabulum.

The *morbid anatomy* is visible in arthrograms (Figs. 4 a, 5, 6, and 7). The medial part of the acetabulum is empty before the femoral head is felt to pass over the ridge (Fig. 4 a), which means that it is not in contact with the joint head. The pressure from the femoral head is still concentrated wholly on the lateral part of the roof, which is still chondral, and has kinked it cranially. As a result, the concavity of the acetabular roof is divided into a medial osseous part and a lateral chondral part. An intersection between

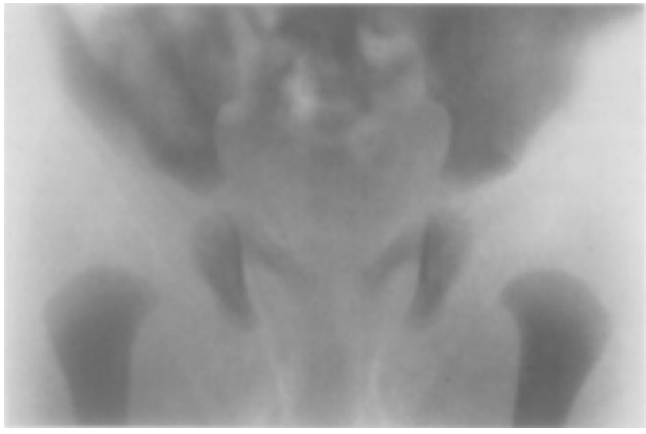


Fig. 2. **Standard X-ray of pelvis of a newborn. The cranial borders of the pubis and ischium in the same transversal plane. The ossification zone of the acetabular roof is clearly visible.**

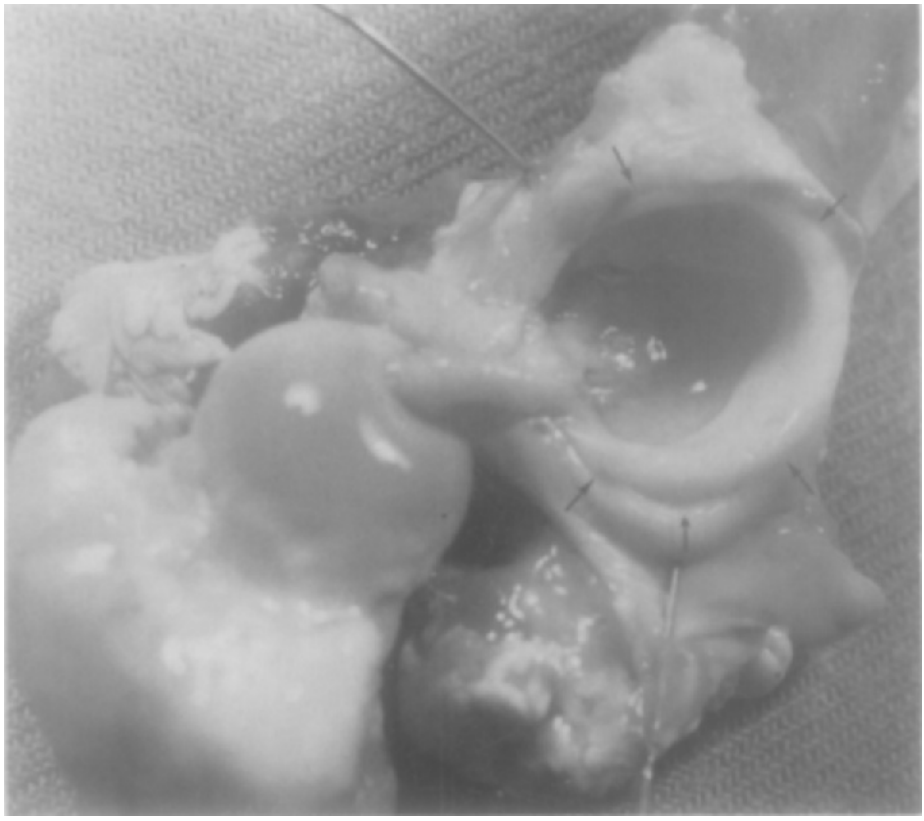


Fig. 3. Specimen of hip in a newborn. Only the dark area in the centre of the acetabulum is ossified, about one-third of its surface. The light periphery is entirely chondral and comprises two-thirds of its surface. The joint capsule is attached to the outer side of the acetabulum 2—3 mm from the rim, with resulting formation of a periacetabular recess all round the outer side (the recess is indicated by arrows).

the two concavities must form a ridge; this *ridge is visible where the femoral head loses its contact with the acetabulum.*

*Abduction brings about a reduction: The kink, the lateral concavity, and the ridge are eliminated at the reduction. They reappear after the corresponding dislocation manoeuvre. Consequently, the ridge visualised by arthrography in our children corresponds to the ridge that can be felt during the performance of Ortolani's abduction manoeuvre.* These reversible changes cannot be expected always to remain visible when the joint is opened and the head removed for inspection of the roof, because the pressure of the head is then eliminated.

Both cranial kinking of the acetabular roof and the ridge phenomenon were present in all the 9 children who were examined at an early stage by arthrography. In 2 of them the ridge bilaterally was more distinct (Fig. 5); the two concavities here intersect each other at almost right angles. Luxation

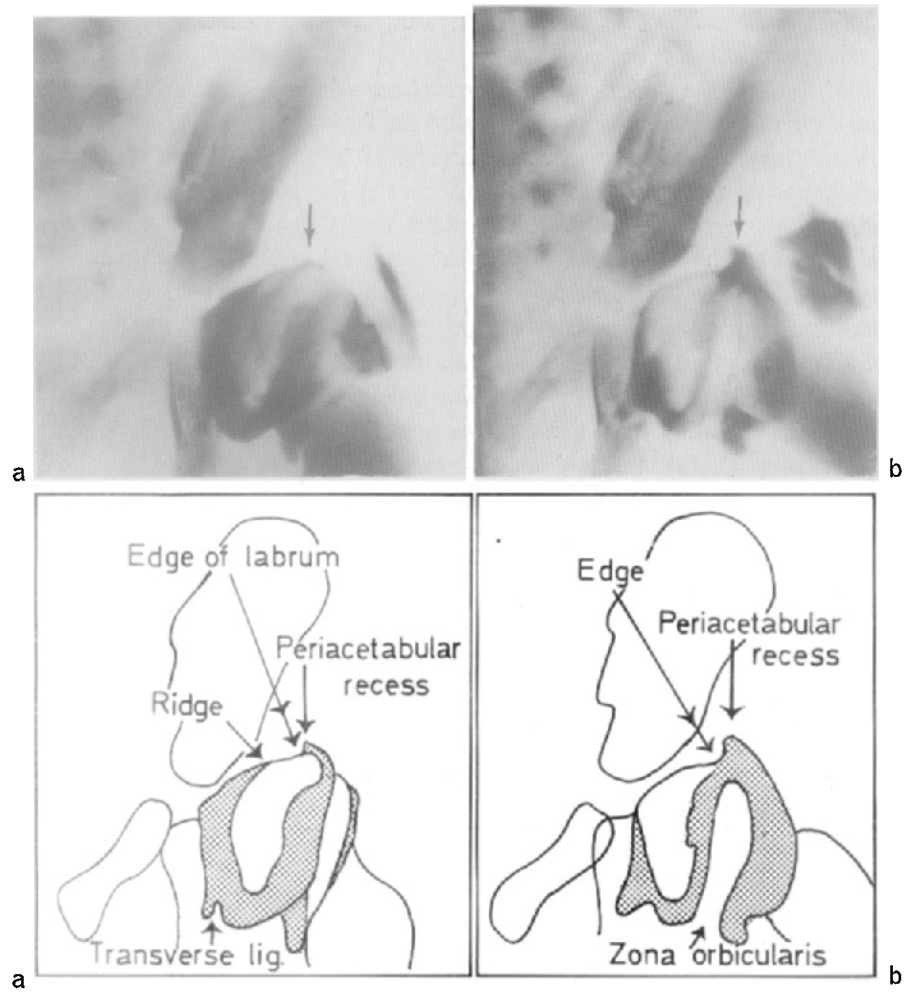



Fig. 4. The ridge phenomenon

a) The dislocated head has no contact with the medial part of the acetabulum. Its pressure kinks the chondral part of the roof cranially and, as a result, the roof is divided into a medial and a lateral concavity. The intersection between the two concavities forms a ridge ( ↘↙ ). The periacetabular recess ( ↓ ) indicates the edge ( ↘↙ ) of the labrum.
b) After reduction the acetabulum is one concavity up to the edge of the labrum ( ↘↙ ). Its pressure is distributed over the entire acetabulum. The kink and the ridge are eliminated.

with the head outside the acetabulum and with the labrum infolded by the dislocated head could not be demonstrated in any of the cases.

*Secondary changes* may arise at three sites around the line between the bony margin in the acetabular roof and the lesser trochanter, namely 1) in the osseous margin of the roof, 2) in the head, and 3) in the neck; usually they are combined (Fig. 6). The initial appearance of the changes, as well

as their connection with the dynamics of the dislocation and with one another, are of interest.

*Ossification defects in the acetabular roof* are seldom visible as early as the first days of life (Fig. 6 a); they usually develop at the age of 1 to 3 months in bone tissue that is normal at birth (Fig. 7). They may appear shallow or cup-shaped or more well marked at the site of the bony margin of the roof, and are often associated with retardation of the normal decrease in the inclination of the bony roof during the neonatal period. This "dysplasia", "hypoplasia", or "false acetabula" gradually increases or remains until reduction takes place.

Such ossification defects in the acetabular roof were found in 33 hips of 24 children (Table II). In 4 children such defects also developed on the side on which no gliding over a ridge was noted. The defects in the "healthy" hips were probably residual changes after dislocation which had healed after spontaneous reduction and stabilisation of the joint prenatally.

*Changes in the head of the femur* are more common than in the acetabulum and in the neck. The ossification of the head is retarded and proceeds slowly. The bone nucleus may be wholly (Fig. 7) or partially (Fig. 6) divided into two parts by a frontal or sagittal ossification defect, either shaped like the

*Table II. Secondary bone changes in 81 children with 114 dislocated hips*

| Localisation | No. of children | No. of hips |
|---|---|---|
| Acetabular roof | 24 | 33 |
| Head | 28 | 43 |
| Neck | 21 | 32 |

*Table III. Secondary bone changes.*

| Localisation | No. of hips | |
|---|---|---|
| | During the course | At after-examination |
| Acetabular roof | 33 | 8 |
| Head-neck | 43 | 40 |

cut of an axe or lamellar. Marginal ossification defects, giving the bone nucleus an irregular shape, are often present as well. The bone structure primarily or secondarily shows bulbiform rarefactions and hypermineralised clumps. The head as well as its bone nucleus often become flattened.

Such changes in the femoral head were noted in 43 hips of 28 children (Table II). Over-bridging of the ossification defects in the head begins at about 1 year of age. The bony structure and the shape become slowly normal up to the age of 5 to 8 years. Flattening of the head and incongruence with the acetabulum may persist, however, especially if bone changes have also been present in the neck.

*Changes in the neck of the femur* are often visible, initially, as small ossification defects shaped like an axe-cut or as a step-like progressive break (Fig. 6) in the bone close to the epiphyseal cartilage, and may appear before or after the ossification of the head. When the ossification of the head begins, the axe-cut in the neck often proves to be a continuation distal to the epiphyseal cartilage of a lamellar ossification defect through the head and, like this, it is frontal or sagittal.

The axe-cut or break may grow deeper and wider to become cup-shaped; this weakens the neck and may result in ante- or retroversion of the head and in varus deformity of the neck (Fig. 7 g). Bulbiform rarefaction, hypermineralised clumps, as well as bone absorption, are often present as in the head.

Femoral-neck changes occurred in 32 hips of 21 children and were in every case associated with lesions of the head.

The bone changes in the neck disappear partially or entirely before the age of 5 to 8 years, except for any varus deformity, which may persist.

Distinct but slight femoral-head changes developed in 4 hips of 4 out of the 39 children who were left untreated because the instability was not attended with constant dislocation and became quickly corrected. In these 4 hips the bone changes disappeared completely. Dislocation with abnormal pressure could have been present prenatally and caused the changes. Too ungentle or repeated examinations are another possible cause that cannot be excluded.

Bone changes also developed in 4 hips without demonstrable instability in 14 children with instability of one hip, for which they were treated by immobilisation in a position of abduction. These bone changes disappeared only partly, but in no case did they cause any apparent functional disturbance, apart from some limitation of abduction.

## Follow-up examinations and results

70 of the 81 children were re-examined at the age of 5 to 7 years. As regards the other 11, the results were assessed from the last examination at the age of 2 to 4 years. Clinical and radiographic results will be reported separately in the following.

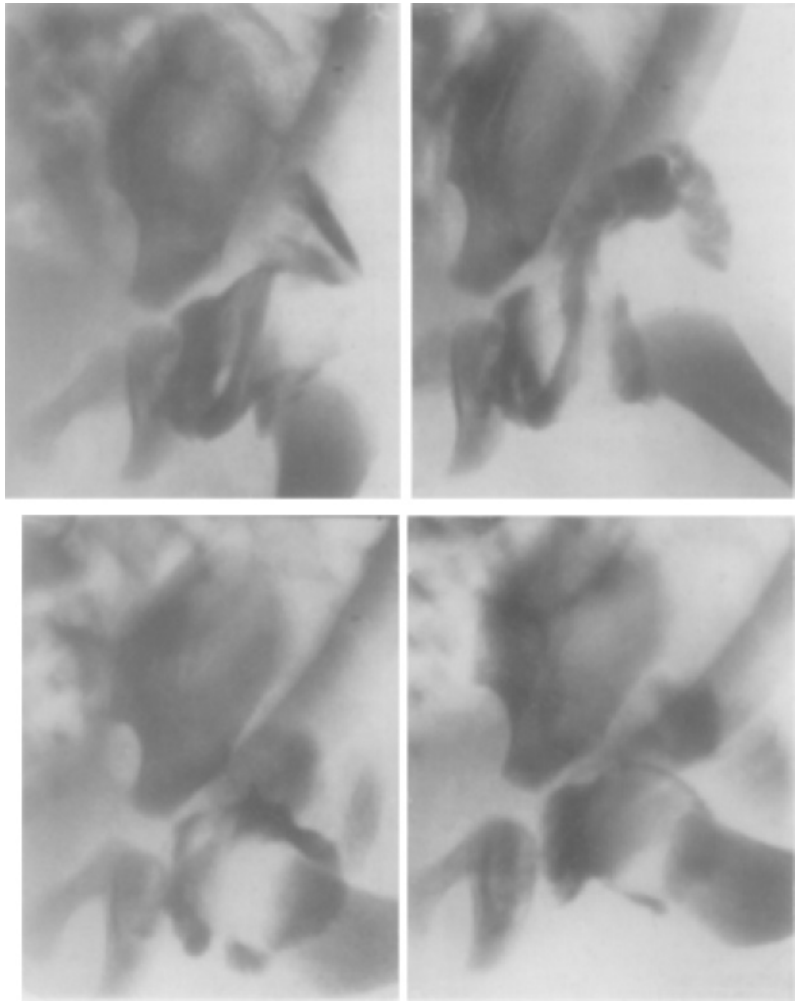



Fig. 5.

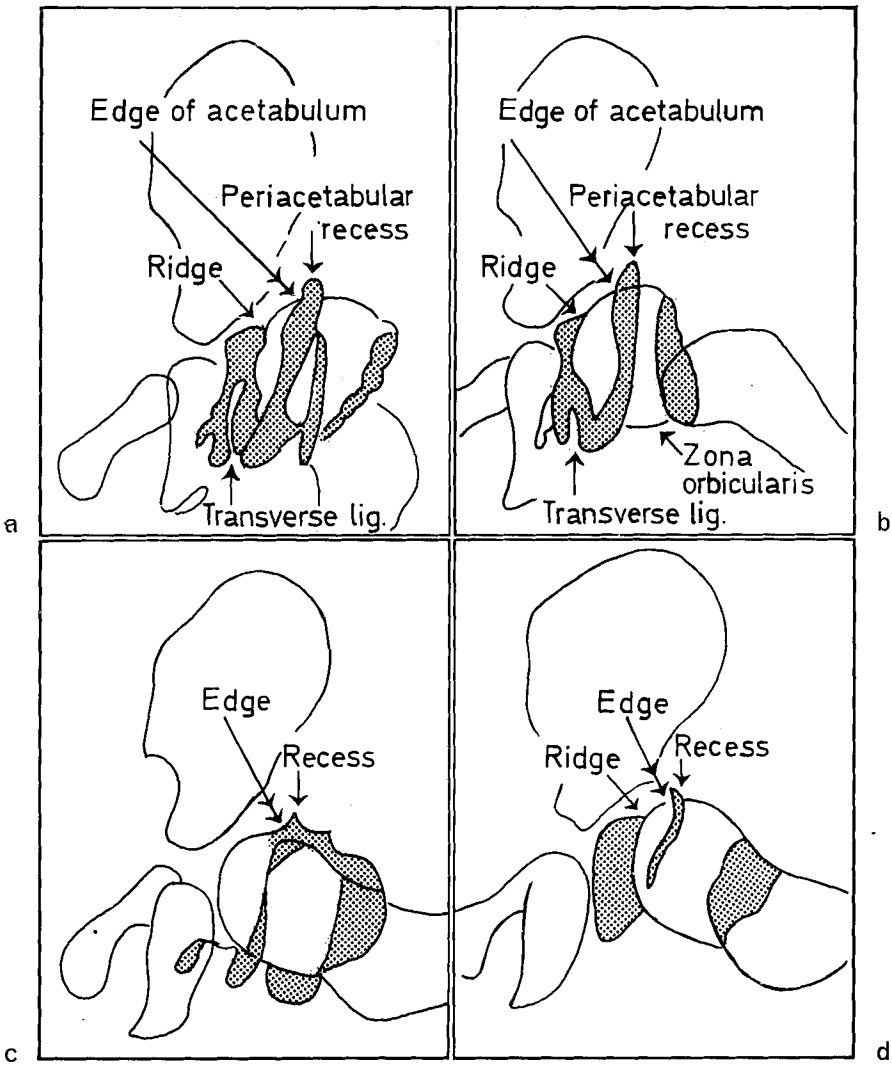


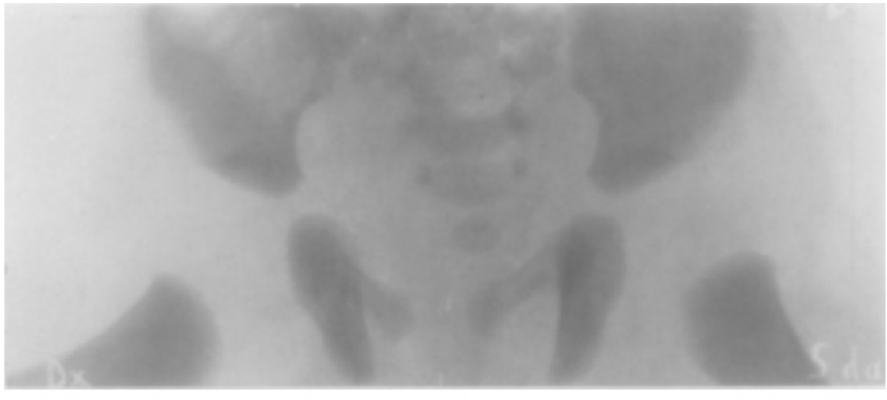

Fig. 5. A 1-week-old child with instability of the hip

a) Extension: The dislocated head kinks the chondral part of the acetabulum cranially with resulting formation of a ridge (↘) at the site of kinking. The periacetubular recess (↓) marks the cartilaginous circumference of the acetabulum from the cranial rim (↘) to the transverse ligament (↑). The cranial labrum is not infolded but instead kinked cranially.

b) 45° abduction: Dislocation. The cranial kinking of the labrum (↘) and the ridge (↘) are less marked.

c) 90° abduction: Reduction. The pressure of the head is distributed over the entire acetabulum. The ridge and the cranial kinking of the labrum (↘) are eliminated.

d) 90° abduction: Repeated, more marked, dislocation provoked by light pressure from behind on the proximal part of the femur. The cranial kinking of the labrum is visible and is more marked than before.

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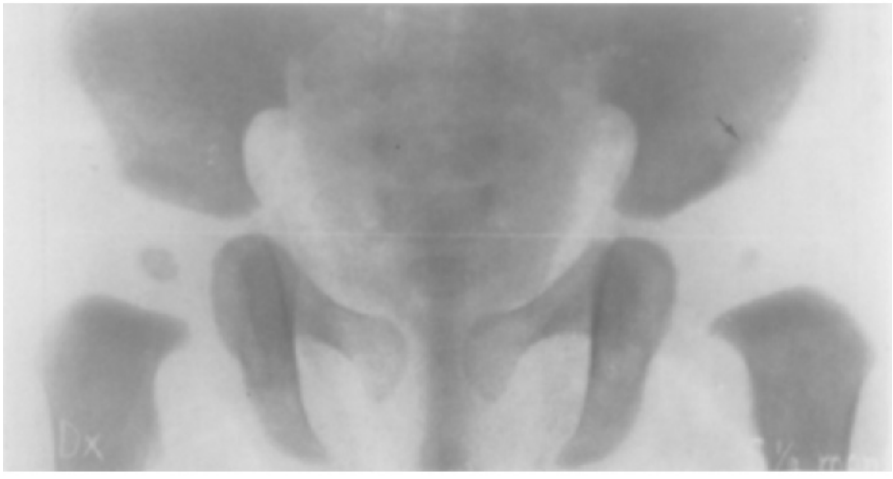


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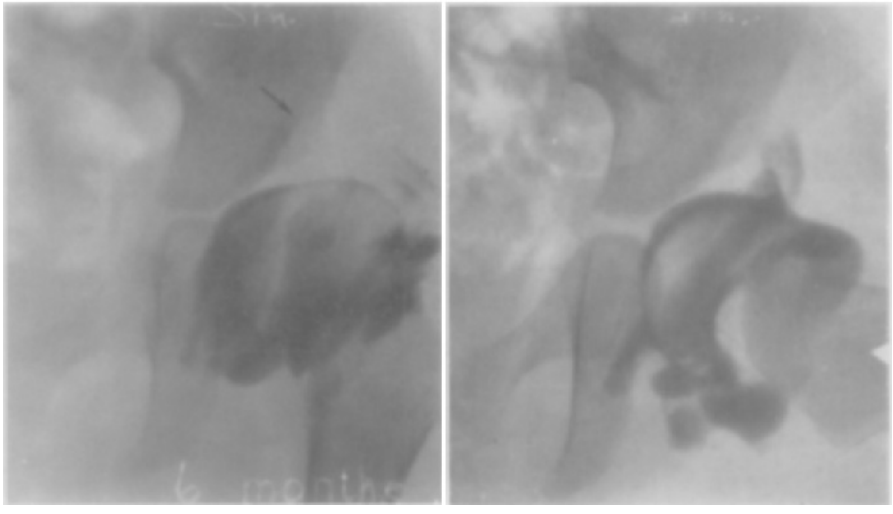

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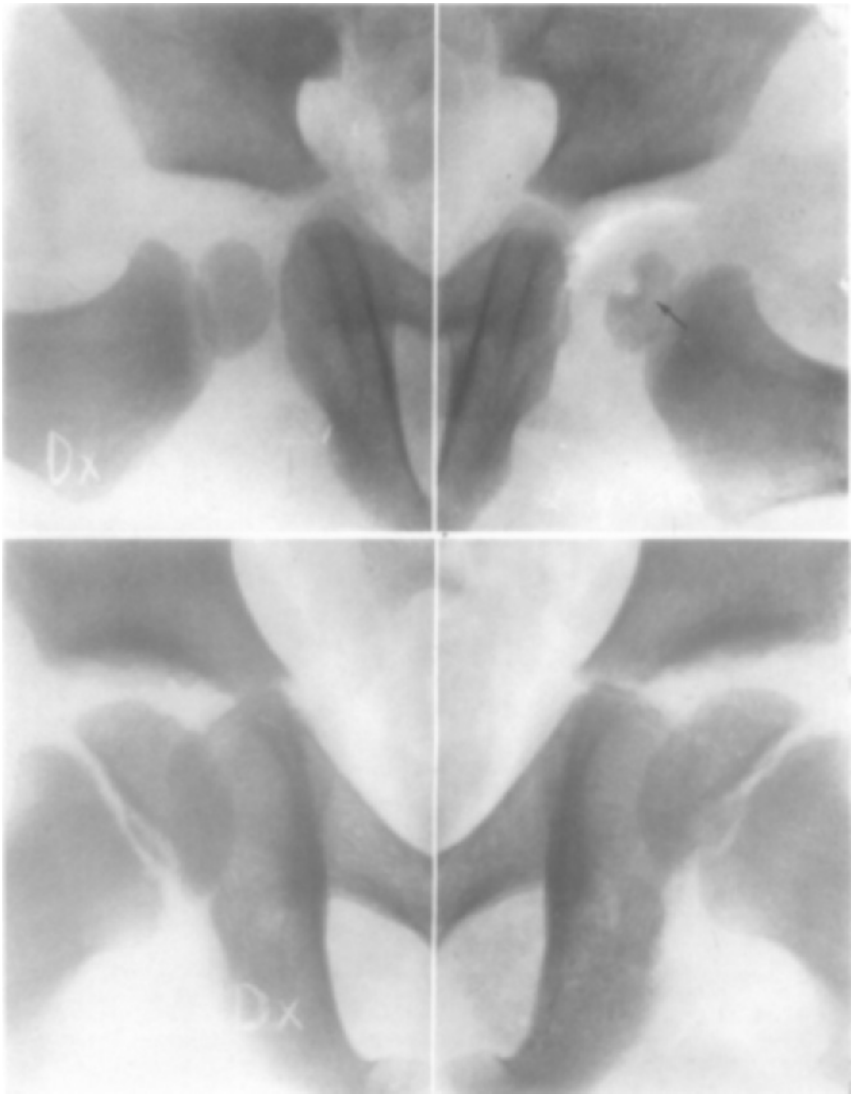
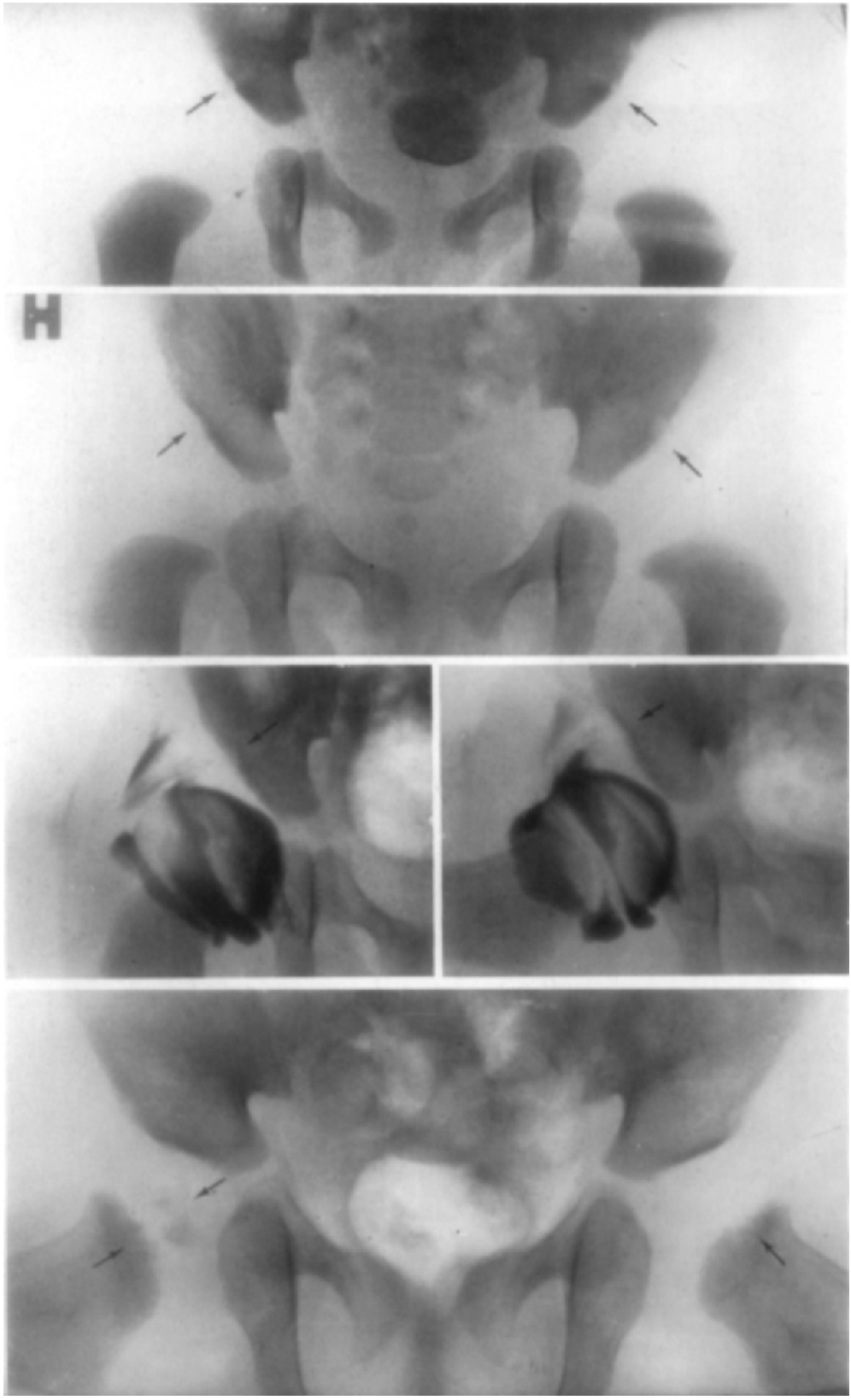



Fig. 6. Slight secondary bone changes in the roof and head.
a) 5 days. No bone change in the acetabular roofs.
b) 5 ½ months. Ossification defect in the left labrum (↘). The bony surface of the right acetabular roof is normal; the inclination of the bony roof on the left side has not decreased normally because of retarded ossification.
c) 6 months. Extension: The joint head is dislocated. Its pressure is concentrated on the chondral part of the acetabulum, kinks it cranially, and is transmitted to the ossification defect (↘).
d) 6 months. 90° abduction: Reduction causes the pressure to shift to the caudal part of the acetabulum, thus relieving the roof and the ossification defect. The kinking is eliminated.
e) 2 years. An axe-cut-shaped frontal ossification defect (↖) is visible subchondrally in the left joint head. The vacuum phenomenon shows that the cartilage is normal over the bone defect.
f) 4 years. Only suggested dysplasia of the left acetabular roof and slight structural change and flattening of the joint head.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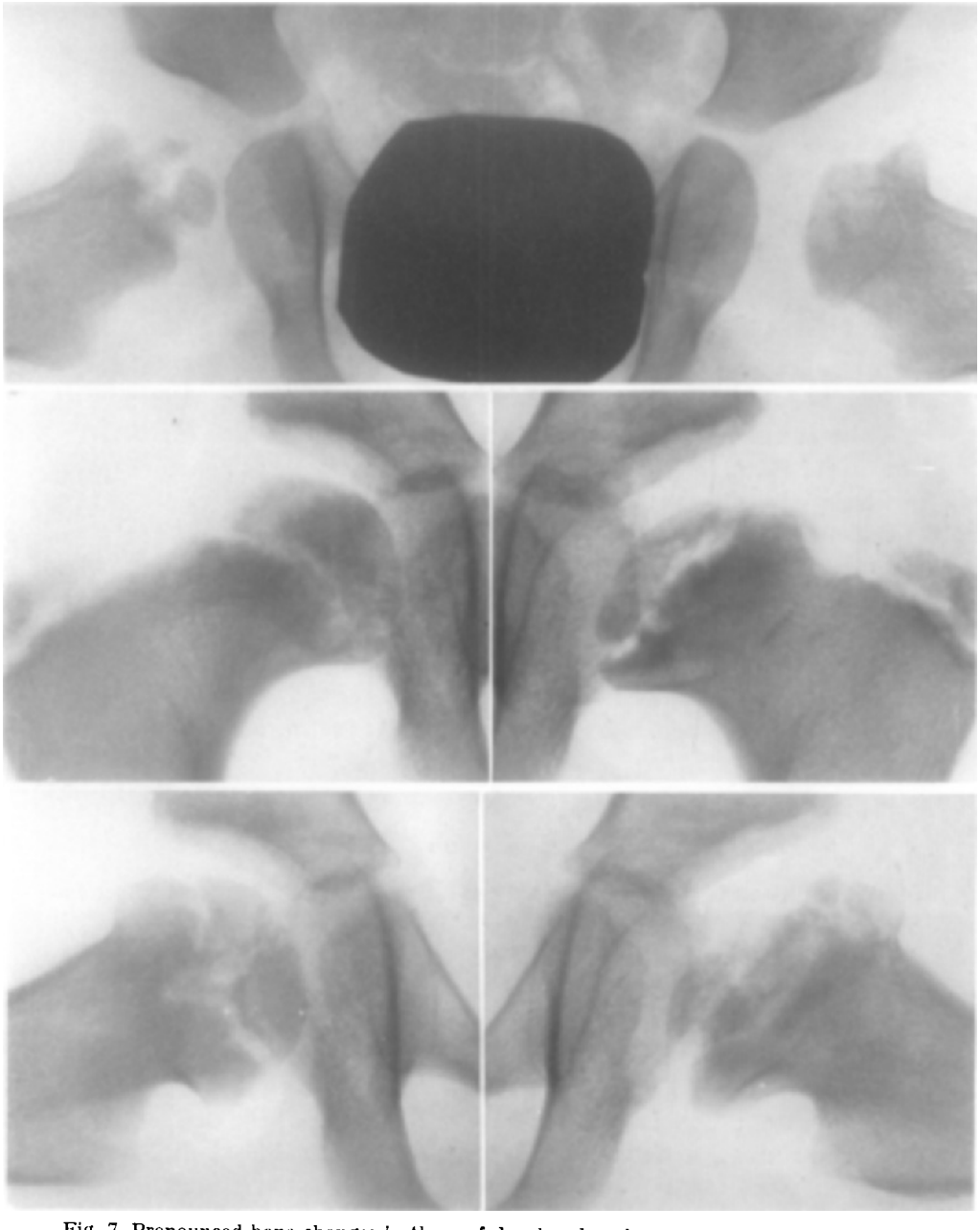


Fig. 7. Pronounced bone changes in the roof, head and neck.
a) 1 day. Minimal ossification defects (↙ and ↘) in the acetabular roofs.
b) 7 weeks. The ossification defects have increased in size and the inclination of the bony roofs has not decreased.
c) 7 weeks. Extension: The dislocated joint head presses the lateral part of the acetabular roof cranially. The pressure is transmitted to the bone defect (↙).
d) 7 weeks. 90° abduction: At reduction the pressure of the head on the roof and the bone defect is eliminated.
e) 7 months. (After treatment in an abduction splint for 2 months.) Only small remnants of the bone defects. The inclination of the bony roofs has become normal. A frontal slit-shaped ossification defect is seen in the right joint head (↙), extending in the shape of an axe-cut into the neck close to the epiphyseal cartilage (↗). The ventral border of the femoral neck is pressed distally (↖).
f) 12 months. Progress.
g and h) 4 years. Persisting dysplasia of the left acetabulum and deformity of the left joint head with fragmentation of the bone nucleus. Slight changes in shape and

*Clinical results.* In 1 child with a bilateral ridge phenomenon dislocation of one hip could not be reduced either by splintage or by other closed orthopaedic measures. Open reduction was performed at the age of 1 ½ years. As regards the other 113 hips, reduction was achieved by treatment in a splint and resulted in permanent stability. At the follow-up examination all the children were subjectively free from symptoms. Objectively, Trendelenburg's test was negative and walking ability normal in all the cases, but a slight limitation of abduction was noted in 10 cases.

*Radiographic results.* An ossification defect in the *acetabular roof* was still present at the follow-up examination in 8 hips of 6 children (Table III). In one of them, who had dislocation of one hip joint, extensive changes were also present in the femoral head and neck with varus deformity. In the remaining 7 hips the examination showed only slight dysplasia of the acetabular roof without any other radiographic abnormalities.

Changes in the *femoral head*, possible also in the *neck*, were noted in 40 hips (Table III). They were designated as slight in 19, moderate in 8, and severe in 13 hips. The latter group was characterised by marked deformity of both the head and the neck. Varus deformity of varying degree was noted in 11 hips of 9 children, in 2 of them so severe that corrective osteotomy was performed.

## Discussion

With respect to *treatment*, our series of cases differs from other series reported at this symposium, in that we left some clear-cut cases untreated. This policy had no ill-effects in the form of persistent dislocation or dysplasia of the acetabulum.

Many workers use immobilisation in the abducted position for every unstable hip, irrespectively of the character of the instability, as "immobilisation in the abducted position will not do any harm". Long-term immobilisation, however, can be followed by more or less marked bone changes in the head and neck of the femur, possibly as a result of nutritional disturbances in an abnormally fixed position.

As regards the *X-ray diagnosis*, Caffey, 1950, states: 'Roentgen diagnosis during the neonatal period and first months of life is exceedingly difficult and often congenital dislocation can be neither identified nor excluded satisfactorily on the basis of roentgen findings'. Andrén and von Rosen, in 1958, published a new projection with inward rotation and 45° abduction of the legs. It was claimed to 'demonstrate hip dislocation with certainty' in the newborn; a line through the long axis of the femoral shaft should pass through or cranially to the lateral edge of the roof. But, as will be seen from Figs. 4 and 8, this new projection can be misleading and, like the old one, it

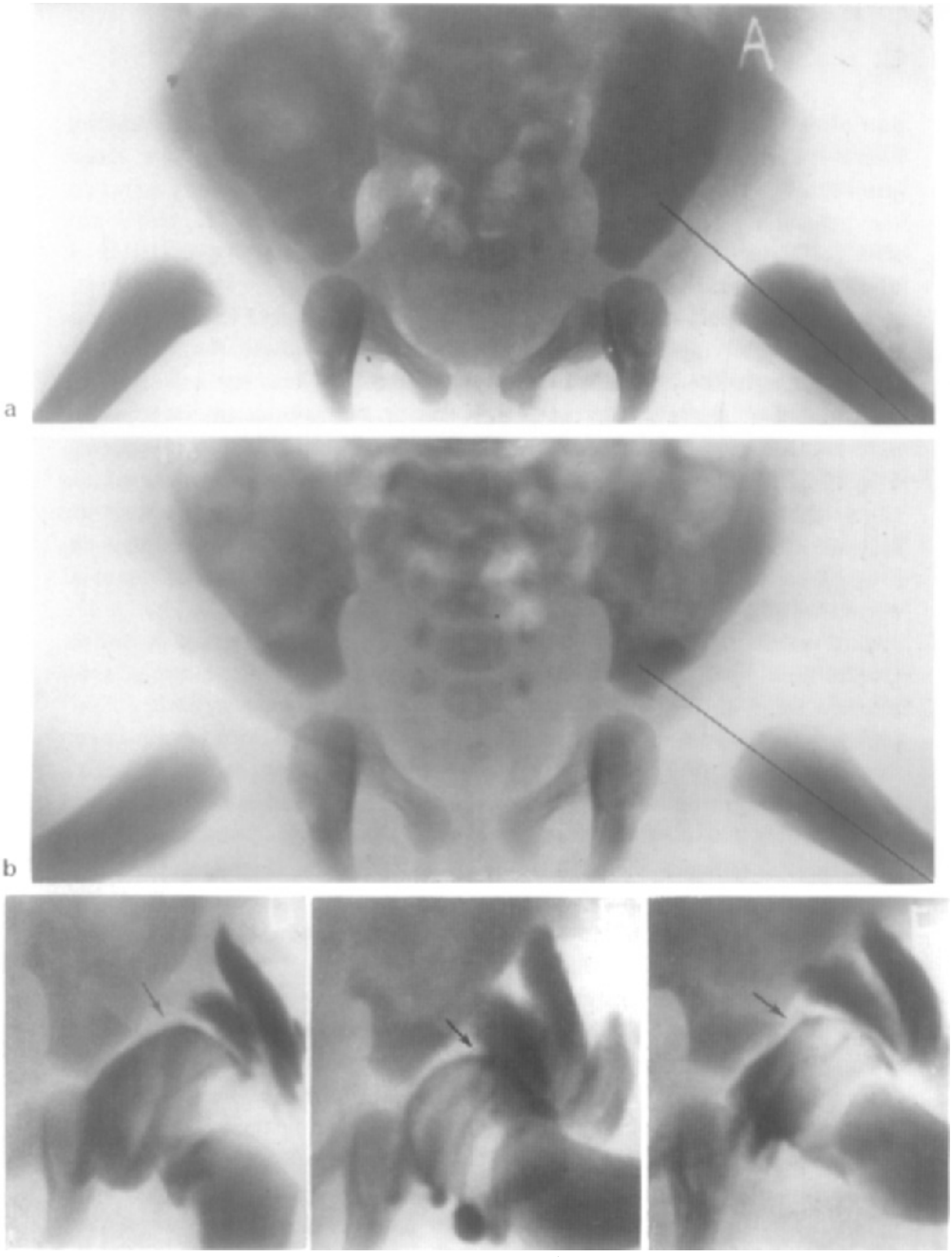


Fig. 8. Limitation of X-ray diagnosis

a) According to Andrén and von Rosen, dislocation is present if the extension of the long axis of the femur passes cranial to the bony edge of the acetabular roof when the thigh is held in a position of inward rotation at 45° abduction.

b) Instability can be missed a moment later, however, for instance because the head can be temporarily reduced spontaneously or by slight changes in inward rotation or abduction.

c) Dislocation.

d) Reduction on abduction.

e) Dislocation on abduction provoked by light pressure backwards—cranially.

can often neither identify nor exclude dislocation. It can be misleading because 1) the joint head can be temporarily reduced at this projection, 2) the projection will not always be exact, and 3) the position of the *bony margin of the acetabular roof* varies at varying degree of ossification and *is not identical with the acetabular margin.* The latter is chondral neonatally and situated about 1 cm lateral to the bony margin.

In the early part of our work with neonatal hips we used arthrography as a means of studying the pathological anatomy and, in particular, the nature of the ridge, in the hope of obtaining further insight into the nature of the disease and guidance in the treatment. But arthography is too complicated as a routine method and not entirely free from risks. X-ray examination 1 ½ to 3 months later, on the other hand, will show any deviations from the normal ossification of the acetabular roofs, that is, the condition can be assessed at a time when the clinical findings, including the ridge phenomenon, are not certain. A comparison with films of the hips during the neonatal period will make the assessment easier.

Our arthrographies have shown that the ridge phenomenon is due to cranial kinking of the labrum with resulting formation of a ridge. A well-marked ridge of this type (Fig. 5), observed in 2 cases, was earlier interpreted by orthopaedic surgeons and radiologists (Severin, Caffey, and others) as a labrum that is infolded by a luxated femoral head. The following two details indicate that this is not the case: 1) The periacetabular recess demonstrates the edge of the labrum at a point about 1 cm craniolateral from the ridge; hence the edge is not infolded; 2) A 45-degree abduction of the femur shifts the pressure of the femoral head medially towards the ridge, which will then assume the same flat shape and size as in the other 7 arthrography cases (Fig. 5). The cartilagenous part of the acetabular roof in these 2 children seems to be unusually soft, the well-marked ridge is otherwise of the same kind as the flat ridge in the others. *Accordingly, in all hips of 9 newborn infants examined by arthrography the dislocation was a subluxation caused by insufficient firmness of the chondral part of the roof.* This insufficiency explains the instability of the head in the acetabulum.

Reports on newborn infants with the head of the femur wholly outside the acetabulum, as in older children with inveterate dislocation, have been published by other investigators, but their cases would appear to be exceptions or to have been incorrectly interpreted.

*Secondary changes.* The *changes in the roof* should not be mistaken for the *normal variation* already mentioned and seen in *late ossification*, namely bilateral absence of ossification of the acetabular roof or very small osseous margins with unusually steep, but symmetric, inclination of the bony roof. The remaining ossified part of the acetabulum appears extremely shallow. This is not dysplasia, as Putti believed; for the bony margin appears a few

weeks later and the acetabulum, including its chondral roof, has normal shape, and depth increases and the inclination decreases as ossification proceeds. The chondral acetabular roof is usually normal in firmness and function.

The defects may be produced by the pressure from the dislocated femoral head. The entire pressure is concentrated to the cranially kinked chondral part of the roof (Figs. 5, 6, and 7) and in this pre-osseous cartilage the ossification ceases. If unilateral, the damage results in asymmetry of the hips. The defect demonstrates that there is or has been a dislocation.

Our pressure-damage theory is supported by the fact that reduction, which eliminates this abnormal pressure, is followed by normalisation. This begins with ossification from the bottom of the defect and at the same time the inclination of the bony roof decreases, its length increases, and it becomes normal or subnormal with slightly concave surface. The normalisation of the roof is usually completed when the ossification of the head begins. As a rule, normal conditions of the roof are completely re-instated within the first year of life, but in 8 hips the bony roof remained tilted cranially and became rough and sclerotic. It may then be difficult or impossible radiologically and without arthrography to determine at once whether this residual change is due to failure of reduction or merely to slow normalisation.

*Changes in the head and neck of the femur* are much more common in our cases than in other published series. One—and the main—explanation of this would probably be that more or less uncertain cases with inconstant "clicks", etc., were not included in our series, which meant a more concentrated and selected primary material. Another reason could of course be that very slight radiographic late changes were also recorded in our cases. The fact remains, however, that the changes were pronounced in 11 % of the total number of cases and varus deformity was so severe in 2 cases that corrective osteotomy had to be performed. The possibility cannot be excluded that too rigid immobilisation in the splint could (via nutritional disturbances) have given rise to these changes in the head and neck of the femur.

## *Summary*

The series comprises 114 hips in 81 newborn infants with Ortolani's ridge phenomenon from the period 1958 – 1960.

The nature of the ridge phenomenon was demonstrated by arthrography. The pressure from the joint head kinks the chondral part of the acetabular roof cranially with the result that a ridge is formed at the transition into the osseous part of the roof.

Bone changes in the acetabular roof were present in 33 hips and were still noted at the follow-up examination in 7 % of the cases.

Ossification defects of the head and neck of the femur were present in 43 hips and at follow-up examination found to persist to a marked degree in 11 % of the total number of cases.

Clinical manifestations of these bone changes are usually absent, but 2 of our patients had varus deformity of such a degree that corrective osteotomy was necessary.

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# *Brief contributions to the subject*

NILS LINDSTRÖM, HÄRNÖSAND

My contribution to the discussion on the unstable hips will be a short account of our experiences in the Orthopaedic Clinic at Härnösand. Owing to the situation of our clinic, at a fair distance from each of the county's general hospitals, we were rather late in starting to receive fresh cases. Between 1958 and 1959 only 1 fresh case, in a newborn infant, was referred to us, and in each of the years 1960 and 1962 we received 2 cases. During the same period of time the following numbers of "missed" cases were treated in the clinic: 12 cases in 1958, 5 cases in 1959, 2 cases in 1960, and 1 case in 1961. This means that in the first period, 1958 to 1961, we treated only 6 newborn infants with unstable hips, while at the same time we had 20 "missed" cases. I have now looked through the records from this period and found that the latter group included babies who had earlier been treated on a frame, which had been removed at bathing or changing of nappies. In consultation with the paediatricians in the county it was agreed upon that from then on we should primarily have the care of all infants with suspected hip dislocation.

In the following five-year period we received and treated 15 newborn babies in 1962, 10 in 1963, 22 in 1965, 33 in 1964, and 16 in 1966, all being cases of unstable hips. But each year we still received, on an average, 1 case which had been missed at birth. So, over the period 1962—1966 we treated 96 infants with unstable hips, who were referred to us before they were one week old or, in some cases, at the age of eight days. Over the same period of time we received 6 "missed" cases. It is probably to be expected that a few cases will always be missed at the routine examination after birth, all the more so as all the hospitals in the county, except two, lack paediatric service.

We have placed every newborn infant with an unstable hip in a von Rosen splint, which was not removed at changing of nappies or at bathing. The splint was left on for three months. I have not been able to find any case of redislocation among the 102 "fresh" cases thus treated over the period covered by the study, 1958—1966.

But on looking through the records I noted a detail that seemed worth

reconsidering. I discovered that there were several infants who had not been brought back to us for routine checkings after the splint had been removed at the age of three months. Some infants may, of course, have died or been taken elsewhere for re-examination. Although none has been referred to us again with redislocation, it is not satisfactory, as we should have liked to follow them up to the age of three years.

Therefore, I have in mind to start a card-index system like that used in the tumour centre at the Radiumhemmet, so that children who do not return as arranged, can be called to appear for re-examination. I should like to know your experiences and your opinion as regards this detail of the follow-up of newborn babies with unstable hips.

HANS EMNÉUS, UDDEVALLA

I have not had time for a complete re-examination of the records of my old Lund series dating back to the period 1961—1964. I have been able to confirm, however, that one case was missed in the Maternity Department at Lund in 1964. The case was diagnosed as typical classical dislocation in the autumn of 1965 in the Orthopaedic Clinic at Lund. No other cases were missed over the period 1961—1964.

As was mentioned in my paper of 1966, some of the children had by then been observed for just under one year. During the past year, however, there have been no developments suggesting that the infants born in 1964 would show complications other than those seen in the years 1961—1963. But as I have no new actual figures, I will make some comments in quite general terms.

In the introductory papers read today the most important statement was that made by Andrén referring to the instability of the hip in the first week of life. This is where the age-limit should be set. If the affected joint is treated and reduced within the first week of life, the course will be very favourable. Immobilization in the first week of life is of greatest importance. Towards the age of two or three weeks the clinical diagnosis will be difficult, and this is where radiographs will play a part. After the age of three weeks examination under anaesthesia will often be necessary. The joint must then be dislocated, so as to verify the abnormality. The answer to Weismann's extremely pessimistic report from Israel about their failure of treatment in a von Rosen splint is very likely that the babies were not examined in their first week of life or that the splint was not applied properly. In fact, the reduction was not made immediately.

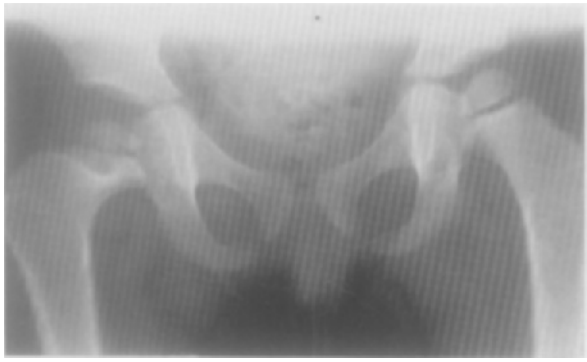

Fig. 1. Girl born 16/5 1965. Reeuction under anaesthesia 1/9 1965. Immobilized in plaster for 3 months. X-ray picture above at the age of 1½ year.

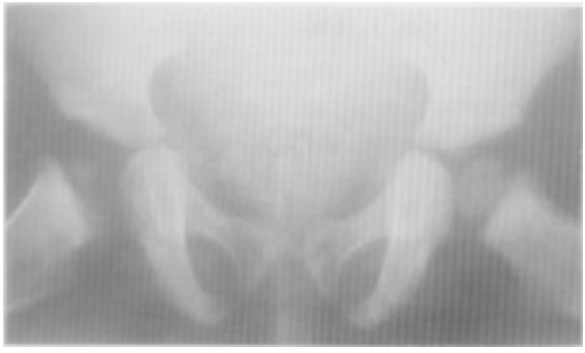

Fig. 2. The same girl as fig. 1. at the age of 2½ years. Note the "osteochondrosis".

Osteochondrosis of capitular epiphysis has been up for discussion. The Lund series from 1961—1964 included no cases that could be so designated. But I can show one case, from the Orthopaedic Department at Uddevalla.

*Case report.* A girl born in May 1965; dislocation was not detected until she was three months old. She was then examined under anaesthesia and immobilized in plaster for three months. When she was six months old, the nucleus of the dislocated hip was very small. A change in the epiphysis can be seen, but at this stage the appearance does not resemble that of osteochondrosis. At the age of 1—2 years there is distinct fragmentation of the epiphyseal nucleus. See figs. 1 and 2. This is of course a case of late treatment of more classical type, and not of treatment in the newborn period.

Erik Jacobsson, Stockholm

It has been asserted that early treatment, that is, starting on the first or second day of life, would prevent the development of the late changes in the head and neck of the femur with which we are concerned here. To verify this I have, in co-operation with Alvin, paediatrician at the Södersjukhuset, during a period of just over one year treated every infant with a proven Ortolani's sign in a splint from its first or second day of life. When the mother left the maternity ward, the baby was transferred to me for continued checkings and follow-ups. This means that there was no elimination of cases of "spontaneously healing" hip with Ortolani's sign, as there had been in the reported material at this symposium. The other day I looked through the records of Alvin's and my series, which by now is 1 ½ to 2 years old, and found that the said X-ray changes were present in 13 out of the 46 infants, or in nearly one-third of the cases. In assessing this figure it should be remembered that during this period Alvin placed every child with "clicking" hips in a splint, and so some babies were treated who, according to the principles applied by me, would have needed no treatment but merely observation.

# *General discussion*

COMPILED BY MAC FELLÄNDER, STOCKHOLM

The main questions discussed at the symposium were:

1. Clinical diagnosis and incidence
2. Treatment
3. X-ray examination
4. Secondary bone changes
5. Missed cases

## 1. Clinical diagnosis

JACOBSSON pointed out that Severin, in his series published in 1941, reported an incidence of only 0.9 per mill. This figure would be representative of the incidence in Sweden. The Stockholm series, at present amounting to 600—700 infants, comprises about 2 per mill of the number of births. In the Uppsala series presented here, the incidence was 20 per mill. It cannot be possible that Ortolani's sign was present in 20 per mill of the cases. This must be a matter of over-diagnosis. Surely, the figure includes insignificant clicks which have nothing to do with Ortolani's sign. The incidence must be of reasonable proportions. The criteria for the diagnosis should be stricter, so that the materials can be compared.

This would also hold true for the assessment of the prognosis as regards secondary bone changes. In the Stockholm area the paediatricians have now learnt to recognize Ortolani's sign, and most of the babies referred for treatment have shown the ridge phenomenon. This may account for the higher incidence of secondary bone changes in this series.

SEVASTIKOGLOU stated that the incidence of 20 per mill reported in the Uppsala series relates not only to babies with Ortolani's sign but to all the babies referred to the Orthopaedic Department. Cases of suspected laxity or a positive provocation manoeuvre by Palmén's technique are also included.

HIRSCH agreed with Jacobsson that the paediatricians who carry out the systematic examination of hips in the newborn must be taught the way to demonstrate abnormal movement of the hip joint. When we achieve greater

uniformity with respect to the diagnosis, the calculations of the incidence will be more consistent throughout the country. It is not possible that the incidence can vary so much as today's reports would suggest. One could accept a wider field of indications, if one knew for certain that the treatment would not cause any damage.

## 2. Treatment

The subject of discussion was how and for how long the babies should be immobilized. According to reports at the symposium, a Frejka pillow was used in Gothenburg and Uppsala and von Rosen's splint in the other orthopaedic departments.

HIRSCH, who had experience with the Frejka pillow, brought up the question whether this method might involve the risk of dislocation being caused during the course of treatment. On the other hand, he asked if the rigid immobilization in a von Rosen splint could give rise to disturbances in the growth of the bone nuclei.

VON ROSEN emphasized that it was important to ensure that the joint head be kept in place for the first few weeks and he did not think that this could always be done with the Frejka pillow in active babies. As regards splintage, he believed that it should not be too rigid but should allow movement of the legs, which should be held abducted in such a position that the head of the femur is centered towards the acetabulum. The splint should not be left on for more than three months.

JACOBSSON mentioned that his patients had been treated with a slight modification of the von Rosen splint and that the splintage had probably been too rigid. In view of the high incidence of secondary bone changes in his series, less rigid splintage was now used.

LINDSTRÖM considered that the splint should be worn continuously. It should not be removed for bathing the baby. Within his region, where the paediatricians had earlier had the care of the cases and issued instructions, he had seen redislocations which he believed were attributable to the practice of frequent removal of the splint.

FELLÄNDER asked von Rosen whether he believed that it was precarious to exclude certain cases from treatment, as was done by Jacobsson's method. Such a decision would require great experience on the part of the examiner and the policy should, perhaps, not be recommended for general use.

VON ROSEN replied that it was difficult to decide which babies needed treatment, and, as for himself, he did not want to take the risk of leaving a baby untreated.

### 3. X-ray examination

L. HULT did not believe that much was gained by X-ray primarily. Of course, it is all right when the examination is carried out by an experienced radiologist like Andrén in Malmö, but such expert radiological service is not available to every orthopaedic surgeon. There is also the risk that we will get the wrong information by the X-ray examination and, further, the idea might gain ground among paediatricians and orthopaedists that the disorder should be diagnosed by X-ray. If it could be proved to have any advantages, X-ray at birth should of course be used.

ANDRÉN replied that, unless it can be properly performed, X-ray examination should of course be omitted. The radiologist must be interested in this abnormality. Most radiologists are not—they simply take a picture. He agreed with Hult that we are likely to miss cases, if we rely on the radiograph.

HIRSCH hoped that the interest in X-ray examination of these children would by now have been stimulated and that the radiologists would acquire the particular technique.

HULT considered that this type of X-ray examination differed from others in that the radiologists must be able to establish a clinical diagnosis, which they should then verify by X-ray.

ANDRÉN had had one case in which the paediatrician had suspected hip instability but in which he was not able to feel any slipping movement clinically, whereas X-ray showed genuine dislocation.

EMNÉUS, with experience from Lund and Uddevalla, where patients are referred from large regional hospitals, has managed without primary X-ray examination.

LINDSTRÖM raised the question whether the repeated dislocation provoked at X-ray examination might injure the epiphyseal nucleus. He emphasized that the infants are subjected to so many examinations: first by the paediatrician, then by the orthopaedist, and finally by the radiologist.

JACOBSSON did not think that X-ray was necessary primarily, if there is clear clinical evidence of a true Ortolani's phenomenon. But up to now their policy has been to examine every infant by X-ray at the first visit. In some cases dislocation was diagnosed clinically, when X-ray was negative. These infants were of course treated. Jacobsson believes, however, that checking by X-ray is necessary later on; in his cases it is usually made when the children begin to walk. This would apply to uncomplicated cases, but as soon as there is some doubt, or when there is limitation of abduction, films are taken earlier. The present routine is to use radiography at the age of 12–15 months and then at the age of 3 years and 6 years. This has meant a fairly great reduction of the X-ray dose.

SCHELLER described the routine in Gothenburg, where the babies are examined by X-ray at birth, then at the age of six weeks, and three months; thereafter repeated examinations are made, if required, depending upon the clinical course. When it is of interest to study the growth of the bone nucleus, the X-ray examination is sometimes repeated.

RIBBING considered that too little is known about the hazards of X-ray examination and that the greatest caution should be recommended. This was the reason why, so far, he has not, unlike Andrén in Malmö, applied a more thorough examination schedule; but he will try it, as he expects shortly to have at his disposal an X-ray apparatus which will permit substantial reduction of the dose by taking the pictures direct from an image intensifier with checking on the television screen.

ANDRÉN gave a report of the dose measurements made at the Institute of Radiophysics by which it has been found that the radiation dose for one exposure equals one week of background radiation, provided that the newborn infant is placed direct on the plate holder and that a high-speed film and large film-to-tube distance are used. The risk of genetic injury is greater at X-ray of the pelvis in a 20-year old patient. The radiation in this case will be at least 100 times as high as that to the newborn baby. A newborn baby, if anybody, can be subjected to X-ray examination without any risk of genetic injury. This is because the dose to the gonads is so small in comparison with that used for larger objects. If we were to hesitate to use X-ray in examining the newborn, we would not dare to make any X-ray examinations whatsoever.

### 4. Secondary bone changes

HIRSCH referred to animal experiments which showed that an abnormal position in the hip joint can result in disturbances of the growth of the nuclei and raised the question whether rigorous abduction treatment could involve the risk of such disturbances.

SEVASTIKOGLOU brought up the question of the association between the mode of immobilization and the occurrence of bone changes. In the Uppsala series a Frejka pillow was used exclusively. Osteochondrosis of the capitular epihysis was seen in only one case. In the Stockholm series the infants were placed in a von Rosen splint and such changes were seen much more frequently.

FELLÄNDER drew attention to a study in children by Hnevkovsky and his co-workers, which was presented at a round-table conference at the SICOT's congress in Paris, 1966. The author observed cessation of arterial blood-flow to the femoral head at extreme abduction.

VON ROSEN believed that the "frog" position is neither dangerous nor unphysiological in the first three months of life. He was surprised at the numerous secondary bone changes that were seen in the Stockholm series, and pointed out the necessity of finding the reason as well as the importance of a continuous follow-up of all series.

### 5. Missed cases

In this part of the discussion the subject was cases of hip dislocation which was not discovered by routine examination of the hip joint in the maternity departments. As regards the diagnosis, *Jacobsson* emphasized that the examination should be made with the baby lying flat on its face with a view to detecting any limitation of abduction. If this was present, particularly if it was noted on one side only, dislocation of the hip could be strongly suspected. With such an examination routinely of infants in their second or third month, the number of missed cases of hip dislocation should be reduced. If the hip cannot be abducted to about 60°, an X-ray examination should be performed, and at this age it can give definite information as to the presence or absence of dislocation.

As regards treatment, FELLÄNDER stated that infants in whom the dislocation is detected at the age of three to six months should also be treated by mild reduction with traction in a position of abduction—inward rotation, that is, the method which nowadays is fairly generally recommended in reduction of dislocation in older children. With this mild reduction the risk of circulatory disorders in the femoral head is smaller. Manipulations under anaesthesia and immobilization in a "frog" position should, therefore, not be used. Felländer mentioned that he had seen a patient whose dislocation was detected at the age of six months and who had been treated elsewhere in the ordinary frog position. The dislocation could not be corrected in this position. Arthrography with checking on the roentgen television screen showed that it became corrected when the leg was held in a position of abduction—inward rotation and dislocated in the frog position. In such cases arthrography would be useful in showing how to adjust the leg to obtain a good position of the femoral head. The examination must be carried out under anaesthesia but does not involve any traumatic manipulation. The use of an image intensifier ensures a low radiation dose. There is no reason to perform arthrography in uncomplicated cases. The arthrographies in the Stockholm series were undertaken to display the anatomy in normal and pathological cases.

VON ROSEN had very limited experience of "missed" cases. In the Malmö series from 1952—1965 there were three cases in which dislocation was detected when the children had begun to walk. He had personally treated

two of them by closed reduction under anaesthesia and subsequent immobilization in plaster by Lorenz's method. The treatment had offered no difficulties. The acetabular roof had developed satisfactorily in both cases and no epiphyseal damage had occurred. The third case had been treated in the same way elsewhere. But the acetabular roof had not developed equally satisfactorily, but clinically the condition has been satisfactory up to now.

Hirsch also uses traction as the primary measure. If this fails, open reduction is carried out, by which he has found that the tendon of psoas acts as an obstacle to the reduction together with the joint capsule, possibly the limbus. The tendon of psoas is divided, and on splitting the capsule it is found that the head of the femur can easily be made to slip into the acetabulum. The psoas tendon is then transferred in front to the great trochanter, thus assuming the ability of inward rotation. If necessary, a shelf operation is made in connection with the reduction.